THE ENGINEER

TOBER 6, 1961 — 28 ESSEX STREET, STRAND, LONDON, W.C.2 — TWO SHILLINGS

THE UNIVERSITY OF MICHIGAN

OCT 27 1961

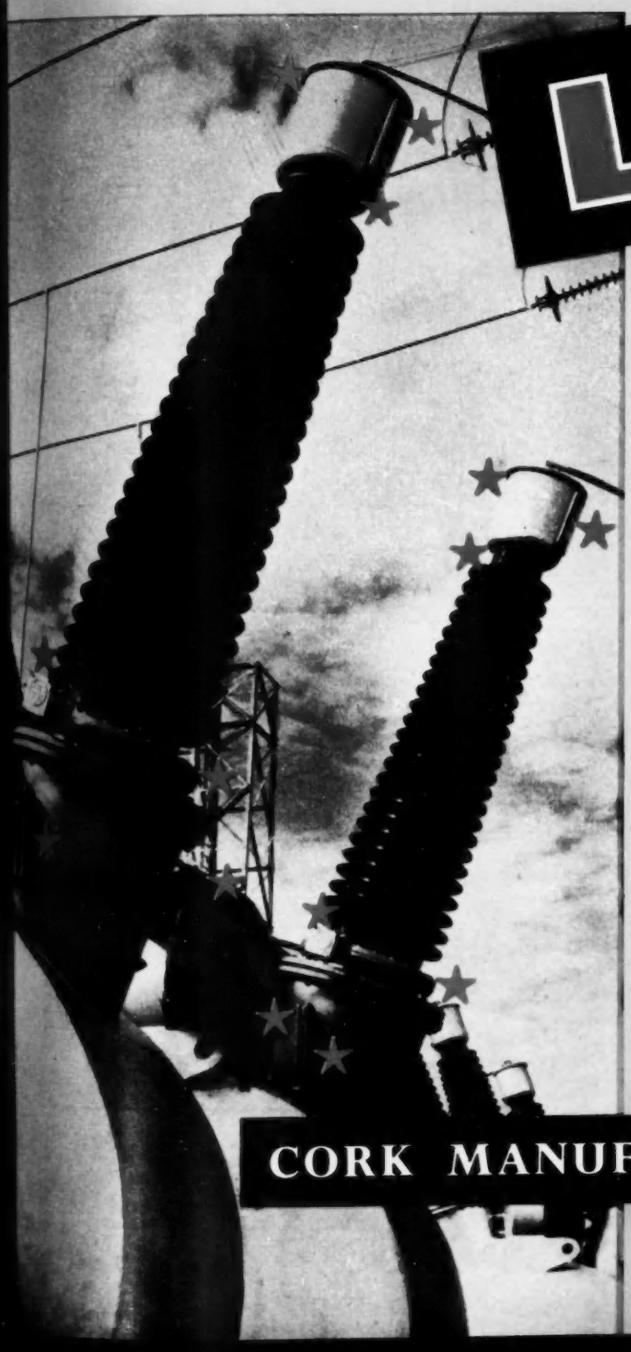
ENGINEERING LIBRARY

Whatever the liquid, whether acid, alkali, oil, solvent or many others, there is a suitable grade of

LANGITE

or NEOLANGITE

Jointing Materials



LANGITE—which for nearly forty years has been used so extensively wherever there is an oil or petrol joint to be kept tight—utilizes the natural resilience of cork bonded together by an original process.

NEOLANGITE also embodies cork, but is bonded with appropriate synthetic rubbers.

★ The illustration, reproduced by kind permission of the Switchgear Division, Associated Electrical Industries Ltd., is a close-up of the terminal bushings of 330-kV oil circuit-breakers in the Kariba Switching Station, Southern Rhodesia; the stars show where LANGITE gaskets are fitted.

CORK MANUFACTURING COMPANY LTD

LANGITE WORKS, SOUTH CHINGFORD, LONDON, E.4
Telephone: Silverthorn 1101 (14 lines) Telex 21883

Enter No. 5234 on reply card

Caissons at Liverpool

One of the four sliding Caissons being built for the Mersey Docks and Harbour Board. The Caisson illustrated has an opening width of 130 ft. with a height from cill to cope of 49 ft. and a moulded width of 29 ft. 6 ins.

All types of Steel Framed Buildings; Fixed and Opening Bridges; Cranes and Mechanical Engineering work; Dock Gates; Sliding and Floating Caissons; Compressed Air Locks; Hydraulic Machinery; Pipe Lines, Surge Tanks, Sluices and other equipment for Hydro-Electric Projects.

SIR WILLIAM ARROL & CO LTD GLASGOW

Arrol

Enter No. 5044 on reply

THE ENGINEER

Established 1856

No. 5515 **OCTOBER 6, 1961** VOL. 212

EDITORIAL CONTENTS

Leading Articles

Accidents Will Happen . . . 557
Stealing Socialists' Clothes . . . 557
Glasgow Electric Trains Restored . . . 558
I. Mech. E. Open Days . . . 558
Reflections on Research at Teddington . . . 559

Articles

100 Years Ago . . . 559
250 Years of Shipbuilding . . . 560
Electronic Computer Exhibition. No. I . . . 564
International Conference on Heating, Ventilating and Air Conditioning . . . 567
International Heating, Ventilating and Air Conditioning Exhibition. No. I . . . 568
New Combine Harvester . . . 572
Adaptable Hovercraft . . . 573
National Economic Development Council . . . 574
Computer for London University . . . 574
Letter to Production Engineers . . . 574
New Buildings at the National Physical Laboratory . . . 575
Fine Wire Butt Welder . . . 575
Mixed Gas Thyratrons . . . 575
New Station at Barking . . . 576
Advisory Council on Scientific Policy . . . 576
Portable Neutron-Gamma Monitor . . . 577
Ticket Issuing Machine . . . 577
Iodine-Treated Lamps . . . 577
Sealed Spiral Conduit . . . 577
Developments in Water Distillation Plant . . . 578
Mechanical Handling of Road Vehicle Loads . . . 578
Fork Truck Stability Tests . . . 578
Secure Switches . . . 578
Improved Diesel Engine . . . 579
Remote Control Globe Valve . . . 579
Safety Hats . . . 579

Mainly Metallurgy

Non-Ferrous Metallurgists in Belgium . . . 570
Conference on the Metallurgy of Beryllium . . . 571
"Corrosion Science"—A New Journal . . . 571

Continental Affairs

The International Motor Show at Frankfurt. No. II . . . 583
Construction of Milan Underground . . . 589
Inauguration of Stalingrad Power Station . . . 591

American Scene

Semiconductor Device for Amplification of Ultrasonic Waves . . . 592
Multiple Diodes for Computers . . . 592
Gas Turbine Driven Tractor with Hydrostatic Transmission . . . 592

BOOKS JUST PUBLISHED . . . 563

OBITUARY Essington Lewis . . . Dr. C. C. Garrard . . . 566

NEWS AND NOTES

Technical Reports . . . 569
Launches and Trial Trips . . . 579
Industrial News . . . 580
Personal and Business . . . 581
British Patent Specifications . . . 593
Forthcoming Engagements . . . 594

INDEX TO ADVERTISERS : PAGE 129 **CLASSIFIED ADVERTISEMENTS : PAGE 122**

NOTICE TO READERS No undertaking can be given to return illustrations or manuscripts. Correspondents are requested to keep copies. No notice is taken of anonymous communications.

SUBSCRIPTIONS U.K. and ABROAD £5 10. 0. p.a., including postage (CANADA £5 5. 0.). Single copies 2s. each, plus 9d. postage. Also on sale at newsagents.

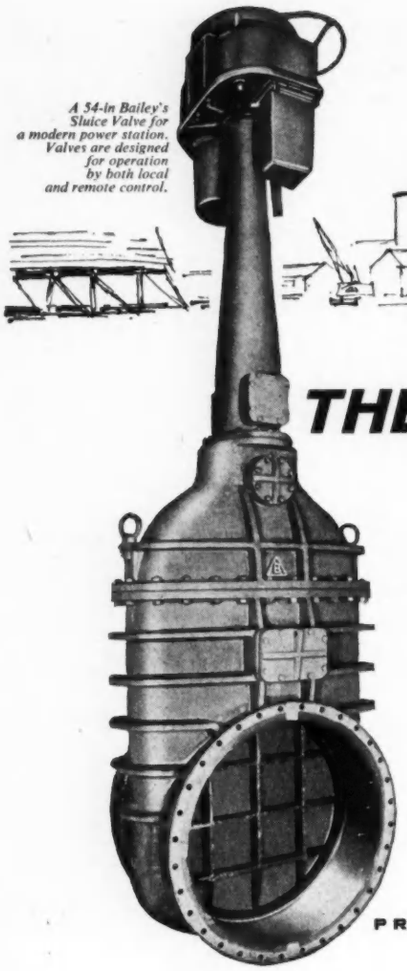
'THE ENGINEER' BUYERS GUIDE Published annually. One FREE copy is sent to all direct postal subscribers on publication and delivered by newsagents to all regular readers. Additional copies are obtainable at 10s. 0d. each. Postage 2s. 0d. extra.

Published every Friday by

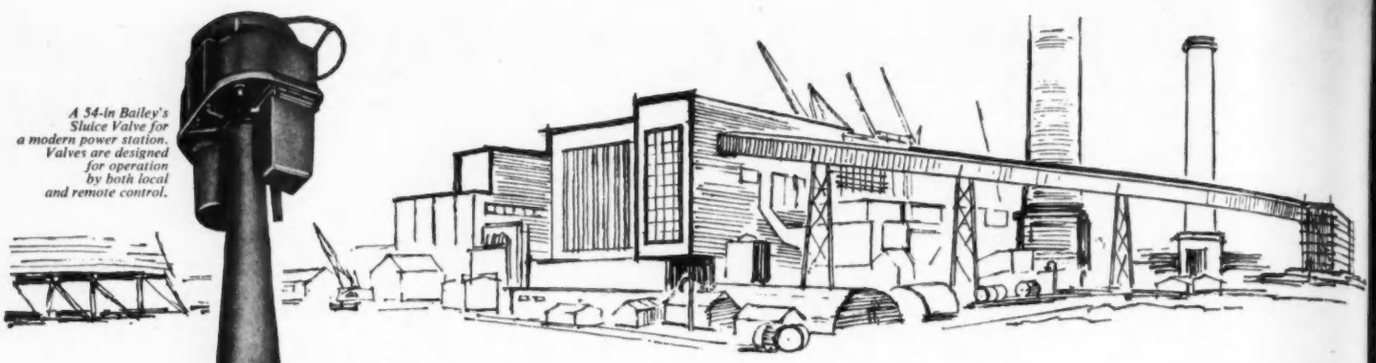
MORGAN BROTHERS (PUBLISHERS) LTD., AT 28, ESSEX STREET, STRAND, LONDON, W.C.2. Telephone : CENtral 6565

MEMBER OF THE AUDIT BUREAU OF CIRCULATIONS

© MORGAN BROTHERS (PUBLISHERS) LTD. 1961



A 54-in Bailey's Sluice Valve for a modern power station. Valves are designed for operation by both local and remote control.



THESE MODERN POWER STATIONS

bank on Bailey's

CHAPELCROSS · WINDSCALE · CALDER HALL · STAYTHORPE · PADIHAM "B"
HIGH MARNHAM · MARCHWOOD · WEST THURROCK · BRADWELL

(Stations of the C.E.G.B. and the Atomic Energy Authority)

These are a few of the great modern power stations which rely on Bailey's valves. Bailey's can undertake complete valve contracts for projects like these, backed by competitive delivery dates and prices.

Their Contracts Division also provides a complete after-sales service to ensure that the valves 'stay on the job'. Advice will gladly be given for your applications.

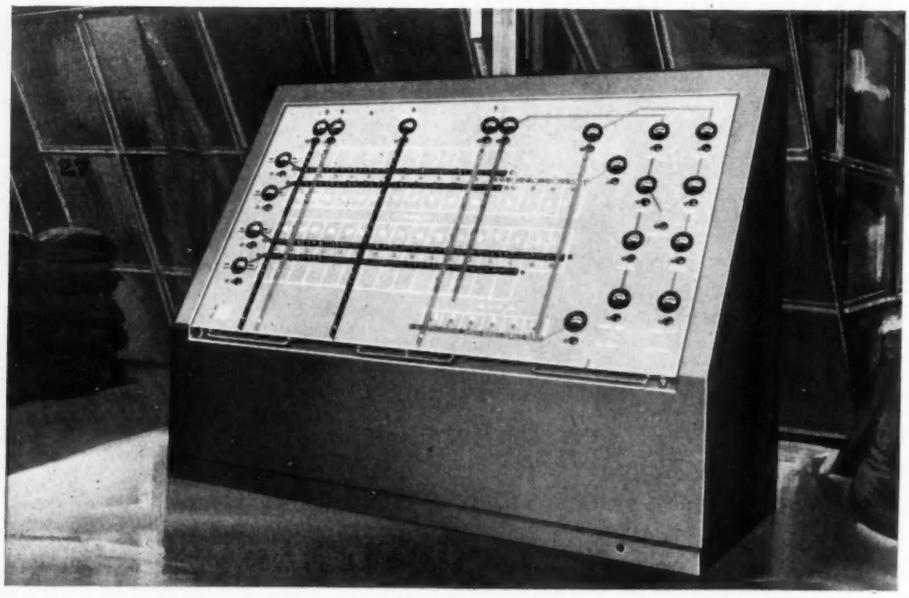
Bailey's REGD.

SIR W. H. BAILEY AND COMPANY LIMITED
HEAD OFFICE & EXPORT SALES:
Albion Works, Patricroft, Manchester. Tel: Eccles 3487 (4 lines)
LONDON & SOUTHERN AREA SALES:
Selinas Lane, Dagenham, Essex. Tel: Dominion 2277 (3 lines)

PRESSURE REGULATORS · SLUICE VALVES · TEST PUMPS · TURNSTILE

Enter No. 5073 on reply card

Bulk Storage Control Panel by ... MEM



The panel is designed to control a number of conveyors operating a bulk storage plant consisting of 33 bins of 7½ tons capacity each.

Each bin has a pneumatically operated slide controlled by a solenoid operated air valve, making it possible to route material from any intake position to any one of the bins.

The panel comprises contactors controlling the solenoid air valves and starters with ammeters for the conveyor motors, dust extractor, etc. Full electrical interlocking of the conveyors and various safety features have been incorporated in the control circuits.

The mimic diagram on the sloping front of the panel gives a clear indication of the state of the plant which extends over an eight storey building. The position of the 100 slides is shown by means of indicator lights. In the event of any dangerous condition arising, an alarm signal is sounded and visible warning is given by flashing lights showing the position of the blockage.

The circuit was developed in co-operation with Mr. G. S. Carr, A.M.I.Mech.E., A.M.I.Plant E., Chief Engineer of Messrs. Crosfields and Calthrop Ltd., manufacturers of animal and poultry foodstuffs.

MEM MIDLAND ELECTRIC MANUFACTURING CO. LTD., TYSELEY, BIRMINGHAM,

Enter No. 5608 on reply

THE ENGINEER

No. 5515 OCTOBER 6, 1961 Vol. 212

ACCIDENTS WILL HAPPEN

There always will be industrial accidents. It is implicit in the nature of human beings that there will be. For it is biologically advantageous that man should be full of curiosity, venturesome, and sanguine. The fact that some action is a bit dangerous to limb or life makes it, especially to the young, more, not less, attractive to perform. It is, therefore, not surprising to find in the Report of the Chief Inspector of Factories for 1960 that in a year when the number of people employed increased and when industrial activity rose relative to the previous year the number of industrial accidents also increased. Nor in the year in which the post-war birth rate "bulge" began to make itself felt through the entry of a more than usually high proportion of young people into industry is it surprising that the incidence of accidents amongst boys and girls rose more steeply than amongst adults. It is not surprising. But it is still deplorable! Some of the blame can, of course, be laid on those who suffered the accidents, for often it can be shown that carelessness or laziness was a contributory cause. But unquestionably the main responsibility for reducing the number of accidents in industry (inevitable though it is that some will occur) should be laid fairly and squarely on managements.

There were over 190,000 accidents (675 of them fatal) in 1960. Since accidents only become notifiable to the inspectors if the sufferers are disabled for more than three days from earning full wages, and taking into account that many of them will have been unable to work for many weeks or months, the loss to industry in 1960 must have amounted to at least a million working days for those who lived to work again and, of course, of a lifetime's work for those who died. What the real figure was one cannot know because of the large number of accidents which kept people away from work for a couple of days or only for a few hours and which did not get reported. Certainly the whole must amount to many millions of working days every year. To that figure there must be added a further loss of working time. A serious accident in a works or on a site affects the work of those not actually involved for many hours; human beings being what they are, each man in the shop concerned, or on the site, wants to see where and how the accident happened and to discuss the matter with fellow workers. Moreover if the management is at fault or is thought to be at fault, and if accidents are frequent, indignation may express itself in bad labour relations and the occurrence of sporadic strikes, leading to further loss.

The fact is that quite apart from the humanitarian considerations which will be uppermost in the minds of good managements, the maintenance of a good safety record pays handsome dividends. But management needs to go much further than mere compliance with the law and the sticking up of a few exhortatory posters. In a Report which has, gloomily, to note for the second year in succession an increase in the number of accidents; and which can offer the sound explanation that more people were in employment and that there was increased industrial activity, both, of course, conducive to an increase in the accident rate, "several industries and firms succeeded in reducing their rates." How was it done? One could go into much detail in reply to that question. But one factor stands out. Where firms maintain satisfactorily low accident rates it will be invariably found that the directors take a deep and abiding interest in the maintenance of safety; and, usually, that some individual in the firm (a whole department in very large concerns) has the responsibility for the maintenance of safety and is answerable to the directors. The price of safety is constant vigilance; and it should be some individual's job to foresee the possibility of accident and guard against it.

STEALING SOCIALISTS' CLOTHES

Elsewhere in this issue we print the full text of a letter sent by the Chancellor of the Exchequer on September 23 to the Federation of British Industries, the British Employers' Confederation, the Association of Chambers of Commerce, the National Union of Manufacturers and The Trades Union Congress. If the proposals made in the letter are implemented and the proposed Council comes into being and proves effective a revolutionary change will have been brought about. Politically, of course, the Conservatives will have walked off with some

of the Labour Party's clothes; but since in the nature of things they have often done so that would not be very surprising. Economically, however, Britain will have abandoned *laissez-faire* and the attempt to regulate the economy by financial means alone. It will have entered upon an era of conscious planning.

But how effective the proposed Council could be in influencing the economy, in increasing the rate of growth of the national output, and in encouraging exports would depend upon the degree to which it proved possible to implement the plans it formulated. Upon the planning side the Chancellor's proposals look sound enough. He envisages a permanent staff capable of collating and no doubt interpreting statistics, directed by a Council upon which the Government, manufacturers, the trades unions and commercial people would be represented. Such a body could survey the plans and proposals of public and private industry and suggest how they could be co-ordinated or altered so as not to strain the output of any particular sector of the economy and so as to ensure that sufficient goods were exported to balance oversea trade. In prospect, under such a Council's advice, the Government would be able so to regulate the economy that alternations betwen high rates of expansion and virtual stagnation would be avoided. But there is a missing factor. There is nothing in the document to suggest how the economy would be controlled to comply with the plan. Yet it is surely essential, if a plan is to be implemented, that it should be possible to ensure that developments take place according to plan. How is it proposed to ensure, for example, that private industry does in fact invest the amounts it said it intended to invest at the time when the plan was being formulated? How will it be ensured that wage rates really do move as they may have been planned to move? None of the bodies represented on the proposed Council has the authority to impose a decision on its members; and though the Government can, in effect, impose its authority on nationalised industries it canot lay down the wage rates to rule within them. If the T.U.C. agrees to be represented it is very unlikely that it would agree to any form of wage policy even if it were able to impose it on the unions. Is it possible for any of the other bodies to impose an investment policy upon private industry?

With what kind of teeth, therefore, is the Government prepared to equip itself so as to be able to implement a plan? If there are no such teeth the Council may indeed be able to foresee the future, but it will not be able to plan it. Both sides of the industry may therefore desire, before giving any definite answer, to ask the Chancellor whether the Government proposes to take powers sufficient to ensure that any plan conceived is carried through according to plan. To do so — in effect to adopt a policy of controls — would be to steal not only the Socialists' ties and socks but to take coat and trousers as well!

GLASGOW ELECTRIC TRAINS RESTORED

This week the electric train services which were withdrawn from the Glasgow suburban line between Airdrie, Helensburgh and Balloch last December resumed normal running. The modifications to transformers shown to be necessary in Brigadier Langley's first interim report on the accidents of December 13 and 17 last have been carried out, and extensive trial running has taken place over the past eight months. We hope that not only the trains, but also public confidence in them, will now return to normal without further setbacks, and that the increased patronage already being gained in the month before withdrawal will continue. The frequency and speed of the service compared with what could be provided by steam had convinced many business travellers of the advantages of parking their cars at outlying stations and riding into the centre of the city. Outside the peak hours, also, the electric railway was seen as a convenient means of travel for social and shopping purposes by many who would not have contemplated braving the Gothic gloom of the old "underground".

At this stage it is appropriate to look at what has gone on elsewhere on the 50 c/s lines of British Railways. Guests at the opening of Barking station last week were conveyed from Fenchurch Street in a twelve-car train of rolling stock built for the Southend service, and comparing it with one of the steam trains alongside, were unanimous that even the hope of travelling sometimes by electric train would cheer regular travellers. It cannot be more than hope at present, because the electric trains must be interspersed with the steam service until a sufficient number have been modified to overcome the traction motor insulation troubles which came to light recently. Outside the rush hours, four-car formations will be used on this line, and some of these will consist of three passenger coaches and a motor luggage van for parcels traffic. On the North-East London line it has been possible to maintain a full electric service to Hertford East and Bishop's Stortford by borrowing stock not yet required elsewhere but reductions of service to Enfield and Chingford continue. Trains for these lines are still undergoing modifications and no date has been fixed for their return in full strength. The troubles here are delaying the high-speed multiple unit sets for the Liverpool Street–Clacton service, but it is expected that some electric locomotives will be transferred to the Great Eastern Line so that these expresses can be hauled with electric traction after the overhead system between Chelmsford and Colchester has been completed. On the London Midland Region the Crewe–Manchester local services are now being worked by electric multiple-unit sets entirely. In spite of some anxious moments for the engineers during a miniature heat wave, their germanium rectifiers showed no signs of distress in high temperatures. The overhead system on the Crewe–Liverpool line is now energised to Edge Hill, and driver training is in progress in this area in preparation for partial electric working in January and a full service next summer. On the whole, October, 1961 looks more promising for British Railways' electrification than did October, 1960.

I. MECH. E. OPEN DAYS

On September 27, for the first time ever, the entire building of the Institution of Mechanical Engineers was thrown open for inspection by its members. There was a special reason for doing so For the occasion marked the completion (or rather the virtual completion since a little decoration still remained to be done) of the reconstruction and extension which has been going on since the premises, No. 3, Birdcage Walk, next door to the original headquarters building, were acquired. Most of the floor space in the building thus acquired has been devoted to offices. But members were able to see there the new reception and entrance hall and newly created rooms of the President and Secretary. The President's is a handsomely furnished panelled room large enough to contain not only a desk but also a table and chairs so that a small committee meeting can be held there or

a party of distinguished guests be adequately entertained. The old President's room at the far end of the President's gallery in the original building has now become a committee room. The removal of offices to the newly acquired building has made it possible to create two new named committee rooms on the mezzanine floor of the original building — the floor on which the reading room is situated. These rooms, which lie immediately above the existing George Stephenson and James Watt rooms off the President's Gallery, are named the Frederick Lanchester and the Joseph Whitworth rooms. Appropriately enough the Lanchester room is to be used principally for committee meetings of the Automobile Division. The opportunity has also been taken to create an extension of the library, which will contain amongst other material volumes of the Proceedings of learned societies and bound volumes of technical periodicals. We have no doubt that the acquisition of the building and the conversion of so much of it into offices will have been welcomed by the staff of the Institution. More space has become urgently needed because of the expansion of the Institution's membership and of its activities. Members, too, we think, will find the Institution has lost little of its warm informal atmosphere. It is still possible to enter its portals and step quietly upon a carpet instead of experiencing the chilly formality of monumental stonework which greets the visitor to the other two major engineering institutions.

The Institution will again be open for inspection by members on November 8th.

REFLECTIONS ON RESEARCH AT TEDDINGTON

For years past engineers have displayed little interest in the discoveries of biologists and physiologists. The work of such scientists might, of course, result in a demand for some product — such, for example, as spraying equipment for the control of insects in agriculture or of a particular kind of laboratory equipment for the study of human behaviour; but that was as far as the interest went. However, judging by some of the purposes of a new Autonomics Laboratory about to be built at the National Physical Laboratory at Teddington the discoveries of biologists and physiologists may be about to have a more direct influence on the design of engineering products. There are certain workings of animal organs which are "autonomic"; that is, like the beating of the heart, they are carried out without the need for the intervention of the brain. An autonomic machine, therefore, would be one which could carry out certain operations without the need for the intervention of a human brain; it should be able to do for itself some of the simpler actions for which humans have to use their brains at present. Hence in the development of such a machine it may well prove desirable to study simple mental activies not only of human brains but of animal brains also. The top floor of the new Autonomics Laboratory at Teddington is being specially designed to house animals which will be used for this purpose.

Two other reflections occurred to us when we attended the ceremony of inaugurating the construction of new buildings at Teddington described on page 575 of this issue. The first, which relates to a new Basic Physics building, is that man, at long last, is beginning to approach the stage at which he will be able to design new materials to meet service conditions instead of having to adapt processes to suit limitations of existing materials. One of the purposes of the new laboratory will be to study how to "manipulate" molecular structure so as to attain a predictable set of properties. The other reflection is that it must often be very difficult to set limits to the fields of work of a research laboratory so that there shall be no overlapping with the work of some other laboratory. The N.P.L. hopes in the new laboratories to do work at very high pressures of the order of 100,000 atmospheres; but the National Engineering Laboratory at East Kilbride is already active in that field. The N.P.L. is also going to study the problems of rolling and extruding metals, thereby entering upon (or rather re-entering upon with up-to-date equipment) a field in which the National Engineering Laboratory, the British Iron and Steel Research Association and the British Non-Ferrous Metals Research Laboratory are all already active. There is not necessarily any harm in such overlapping since no doubt the approach of each of those bodies to the subject will be different from that of the others. No doubt, too, the Council of the Department of Scientific and Industrial Research will ensure that work in such fields is complementary and not competitive.

The Engineer—100 Years Ago (OCTOBER 4, 1861)

Machine Tools

John Robinson, speaking before the British Association at Manchester "On the Application of Workshop Tools to the Construction of Steam Engines and Other Machinery," said lathes had improved rapidly in accuracy of construction and "... in all well-furnished workshops compound slide rests are employed wherever the lathe is geared with sufficient power to permit their use." The "sliding lathe" was another "step in advance" and the use of multiple tools was growing. In one lathe this "... multiplication of cutting tools ... has been carried to the extent of seven." Double face-plate lathes were common, as were gap or "break bed" lathes and screw-cutting lathes. Planing machines had soon lost their original chain motion and the tables were normally driven by rack and pinion or by screw and nut. There was fast return to the table except when the planer was tooled to cut both ways, and multiple tooling was common. Side planers and many special forms of planing machine were also in use.

Drilling machines had "... undergone considerable improvement" and the use of the radial drill was "... increasingly frequent." Multi-spindle drills were in use, together with special types such as the slot drill. Slotting machines had been in use for "many years" and there was also the "... more recently invented" shaping machine or "steam arm." In its simplest form the slotter had no quick return stroke, but the slotted link quick return was in use on some machines. A "wheel cutting machine" employed serrated or toothed steel cutter discs and the process was clearly that of gear milling, though the milling machine proper is not mentioned. Bolt and nut cutting machines of various types were in use, including one type with a self-opening die-head.

Punching and shearing machines "... of enormous power" were in use for punching plates 1¼in thick and for shearing bars and plates "... up to 4in, and even 6in." "It was obvious," said Robinson, "... that the means now placed within the reach of the mechanical engineer are vastly superior, both in variety and excellence, to those which were at his disposal thirty years ago ..."

250 Years of Shipbuilding

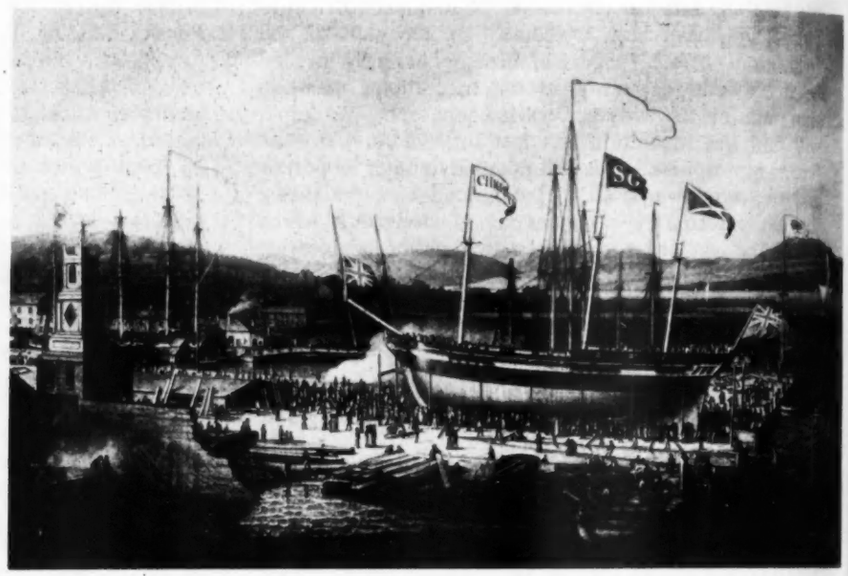
THROUGHOUT the centuries man has been engaged in the building of ships to cross the seas for the furtherance of trade, for conquest, and for local transport, ranging from the coracles of the ancient Britons to the clippers of the nineteenth century and on to modern steelbuilt steamships and motorships. Ships were largely built where materials were at hand, first using wood and then iron and steel, and time has witnessed the rise and decline of many shipbuilding ventures due to one cause or another. Thus it is rather unique that this year Scott's Shipbuilding and Engineering Company, Ltd., completes 250 years of shipbuilding at Greenock and even more unique that the business has been continuously under the direction of one family. This association of seven generations of the Scott family with the business since it was founded is a record of which there is every reason to be proud, and is indicative of tenacity of purpose and great resolution, and integrity coupled with considerable business acumen in meeting customer requirements, displayed by successive members of the family.

It was in 1711 that a Greenock carpenter, named John Scott, began to build herring busses at the mouth of the West Burn, little thinking that the shipbuilding business which he established would still be constructing ships, although of considerably greater size, power, performance and different materials, some 250 years later and that descendants of his name would still be directing operations. Despite the effects of political troubles, expanding trade was favourable to shipbuilding so that, under the founder and his two sons, William and James, the yard prospered and ships were built for other trades and increased in size from the bluff bowed, rounded stern three masted herring busses, measuring about 70ft in length, to their first square rigged ship by 1765. It was not only the size of tonnage built which increased but the yard itself, this being extended and a graving dock of considerable size was built to add to the amenities. Steady progress continued to be made and in 1791 the " Brunswick " to carry 1000 tons real burden was one of the ships completed at the yard.

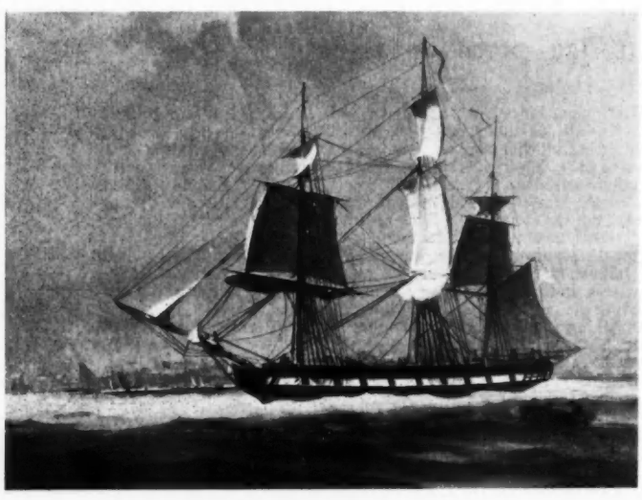
However, interest was not confined solely to shipbuilding, although ground for extensions continued to be acquired ; John Scott (II), whose grandfather was associated with the father of James Watt and who was a student of Watt's inventive work, acquired the Greenock Foundry in 1790. This continued operations under the designation Scott, Sinclair and Co. and was the forerunner of the present engineering department of the company, for by 1825 construction of steam engines has been started and the era of steamships had begun. The first set of engines produced were of 80 nominal h.p., the boilers were of copper and they were installed in the " Trinacria," a ship measuring 113ft 6in by 39ft 6in over sponsons by 21ft 10in beam by 14ft in depth and of 300 tons burden.

Although steam machinery was for long only employed as a secondary form of propulsion, a continual effort was being made to improve its reliability, and of more importance, its economy ; The Greenock Foundry Company, the new name given to the engineering branch in 1859, under the leadership of John Scott (IV), made considerable advances in the design and construction of boilers and engines. The " Thetis," built of iron, was fitted with compound engines of 256 i.h.p. and operating at 115 lb per square inch, the steam being raised in a water-tube boiler, and subsequent trials established the efficiency of high-pressure steam. Another notable experiment was the installation of water tubes at the base of the funnel to utilise waste heat from the boilers.

During this period of rapid change and expansion reference to a few of the ships turned out from the Greenock yard will illustrate the progress made in shipbuilding and marine engineering. For the navy there was the sloop " Prince of Wales " built in 1803 and in 1849 the iron steam frigate " Greenock," measuring 213ft by 37ft 4in by 23ft depth of hold, which was driven by a propeller through gears which raised the engine r.p.m. of 42 to 98·7 r.p.m. at the propeller. Sailing ships included the " Christian " in 1818 from the original west yard, the clipper " Lord of the Isles " in 1853 which was of 691 tons and had a length of 183ft by 29ft beam. It is of considerable interest to note that model experiments were carried out in the graving dock in 1840 and that experiments to test form and rudder were made in Loch Thom. Among the steamers were the paddle steamer " Waterloo " built in 1819 and fitted with two engines

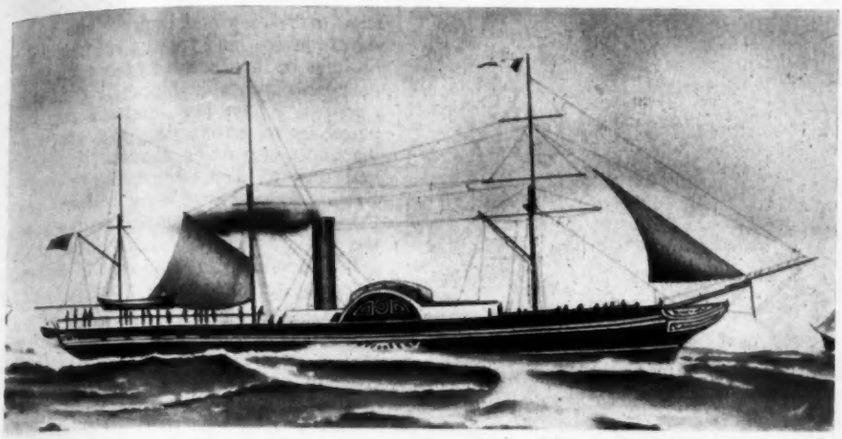


Launch of West Indiaman " Christian " from original yard



Sloop-of-war " Prince of Wales " (1803)

Iron steam frigate " Greenock " (1849)



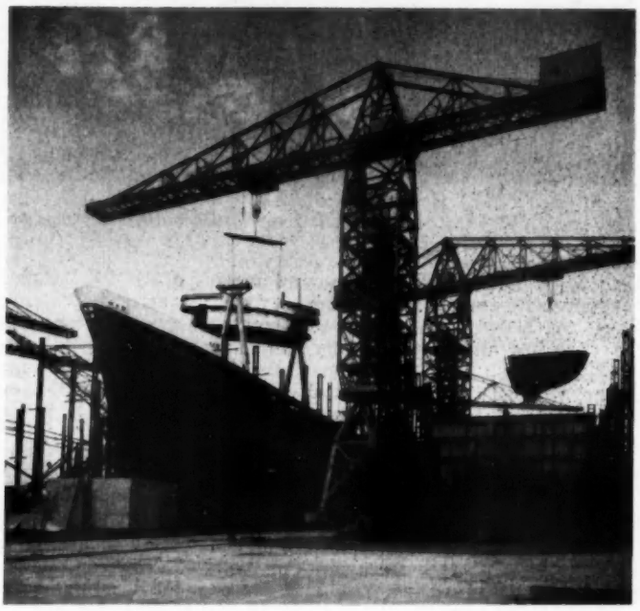
P. and O. steamer "Tagus" of 709 tons built in 1837

of 30 nominal h.p. to give a speed of 9 m.p.h. In 1835 the "City of Aberdeen," 187ft long and of 1800 tons, was completed and had machinery of 200 h.p. installed sufficient to maintain a speed of 12 m.p.h. Two years later the yard built its first ship for the P. & O. This was the paddle steamer "Tagus" of 709 tons, having a length of 182ft by 26ft beam by 17ft 4in depth and side lever engines of 286 h.p. A larger ship, the "India" of 1206 tons, was completed in 1839, and this ship, measuring 206ft 6in by 30ft 9in, had a speed of 10 m.p.h. and engines of 320 h.p. and was the first steamship of the fleet formed to make the passage to India round the Cape of Good Hope.

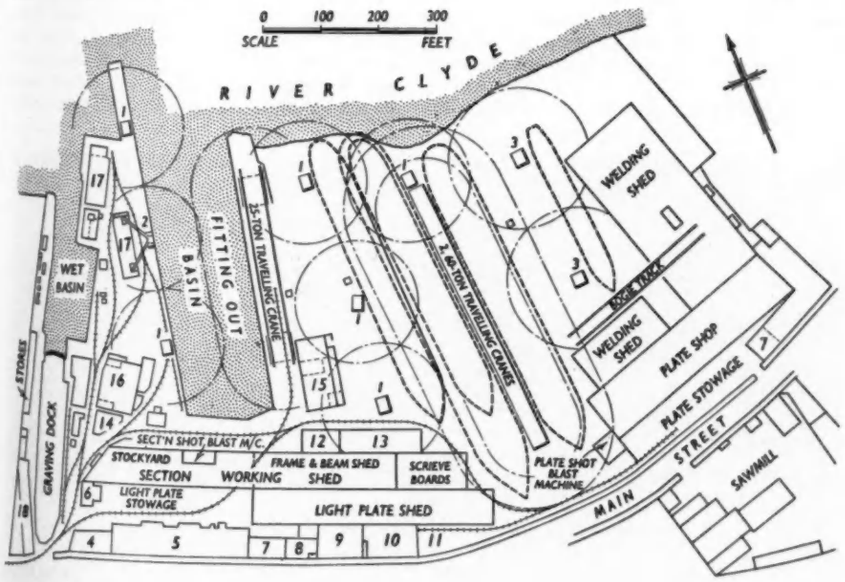
The coming of steam and the use of iron, and later steel, as shipbuilding materials found the yard ready to adopt new techniques and under the control of Charles Cunningham Scott (I), the fourth generation of the family, continued to prosper. He continued the progressive policy of his father, John Scott (II), who had been responsible for the business for nearly fifty years, and with his son John commenced the Cartsdyke yard in 1850 under the style Scott and Co. The second half of the nineteenth century saw the last wooden sailing ship built in the yard, the "Canadian," in 1859, although sailing ships continued to be built of iron and one of the last of these was the four-masted barque "Archibald Russell" which was completed in 1905 and measured 278ft by 43ft beam by 26ft depth and carried 3930 tons.

During the regime of John Scott (IV), and his brother Robert Sinclair Scott, the fifth generation, the firm took a leading part in shipbuilding and marine engineering developments. The Cartsdyke yard was reconstructed and the iron shipbuilding yard and graving dock of Robert Steele and Sons were acquired and on the site the Cartsburn dockyard was laid out and equipped for the construction of naval craft.

Mention has been made already of the tests of the machinery for the "Thetis," and the success achieved sponsored the adoption of this form of machinery for the three ships



Prefabricated superstructure and stern section being placed in building berth

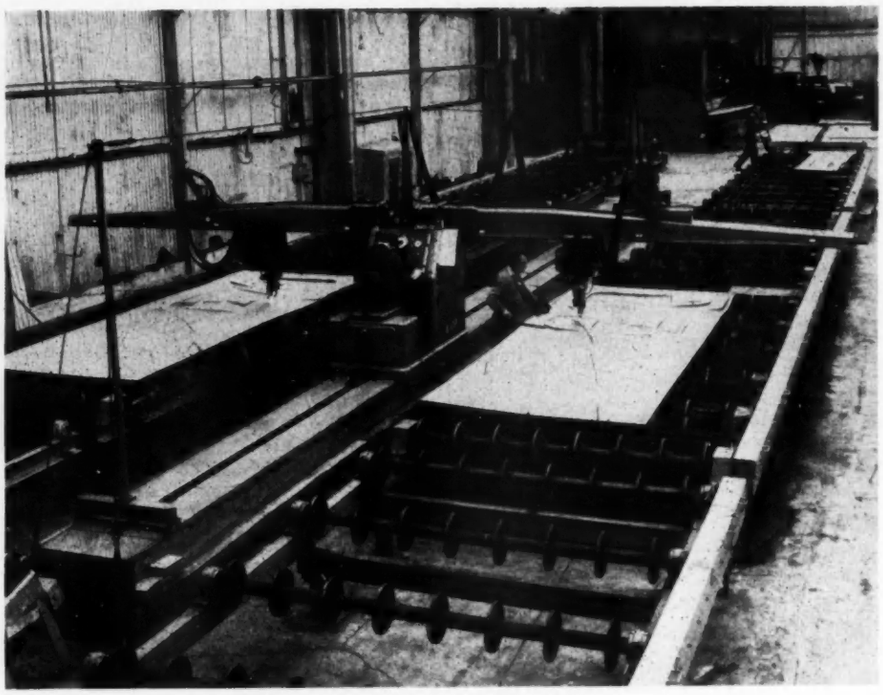


1—12-ton cranes.
2—100-ton cranes.
3—20-ton cranes.
4—Main offices.
5—Drawing office, joiners dept. and loft.
6—Time office etc.
7—Power station.
8—Plant shop
9—Finishing shop.
10—Smithy.
11—Plate furnace.
12—Stores and offices.
13—Battery shed.
14—Welfare.
15—Paint shop, stores and offices.
16—Electrical depts and stores.
17—Engineers' depts. and stores.
18—Plumbers' shop and Admiralty offices.

Layout of shipyard as modernised

building in 1865 for the Holt line to China. These were the "Agamemnon," "Ajax" and "Achilles," and the engines had 30in diameter h.p. and 62in diameter l.p. cylinders; steam at 60 lb per square inch was supplied by two double-ended boilers and the three bladed propeller of 17ft diameter by 26ft 6in pitch was driven at 46 r.p.m. Thirty-five years later the firm built three ships, having the same names, measuring 440ft by 53ft 6in by 35ft and having a gross tonnage of 7040 and representing the rapid progress being made over this period.

Although the company had built a number of sailing cutters in the early part of the century, in the second half steam yachts predominated including several, named "Greta," for members of the Scott family and the "Erin" to the order of Sir Thomas Lipton in 1896. Perhaps the most historic was the "Hinemoa," built in 1876 as a Parliamentary yacht for the Government of New Zealand. This vessel measured 207ft 4in by 25ft 2in by 15ft 2in and 542 gross tons and was propelled at 12 knots by a compound, direct-acting, surface condensing engine of 150 n.h.p. using steam at 65 lb per square inch. "Hinemoa" carried out official duties until 1922 and from 1926 until 1929 when she was sold out of service. She was finally laid up in 1932 and eventually, in 1944, when sixty-eight years old, was used as a target ship. Gunfire having failed to sink the ship demolition charges



Automatic profile cutting machine in plate shop

had to be used — a fitting testimony to the workmanship put into a Scott ship.

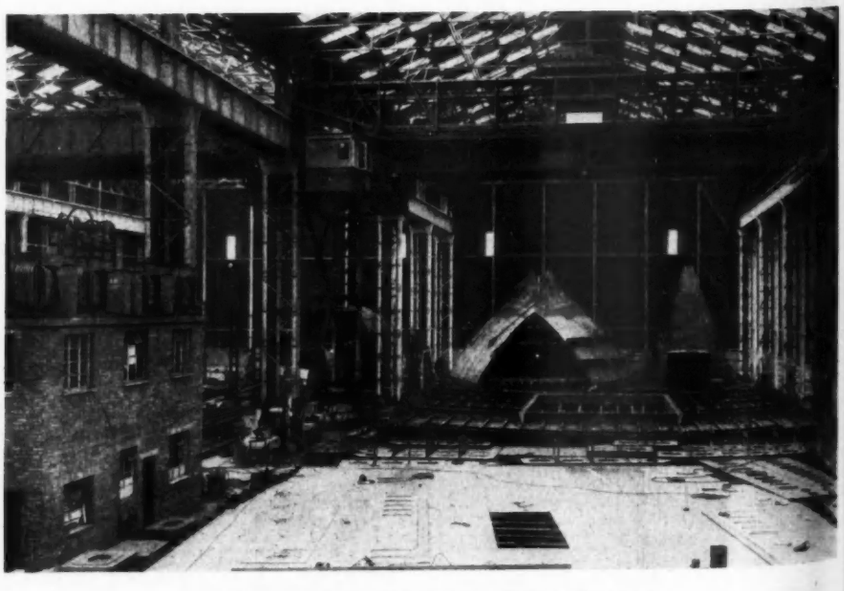
At the beginning of the present century in 1904, the Greenock Foundry Company and Scott and Co. were merged into one company, Scott's Shipbuilding and Engineering Company, Ltd. Later further changes were made and in 1934 an exchange of yards was effected and the yard of the Greenock Dockyard Company, Ltd., which lay between the Cartsdyke shipyard, the east yard, and the Cartsburn dockyard, was joined to the latter while the east yard became the present yard of the Greenock Dockyard Company, Ltd. Trends in design, size and power, already evident in the latter part of the preceding century, continued in the twentieth century and Scotts continued to build ships for existing customers and also added others to the list. The liners "Cassandra" and "Letitia" were built for the Anchor-Donaldson Line, "Hildebrand" for the Booth Line, "Alaunia," "Andania" and "Transylvania" for the Cunard company, and the "Nessian" and "Orubiad" for the Leyland Line. Many cargo ships were completed by the yard, including several of the Holt Company and the China Navigation Company. One of the ships completed for the latter company was the "Fengtien," which measured 267ft by 40ft, had triple expansion machinery of 2146 h.p., a speed of 13¼ knots and arrived at Shanghai less than twenty-six weeks after laying the first keel plate, a time which compares more than favourably with to-day. There was also completed in 1903 the 12,000 tons deadweight "Narraganset," the largest oil ship up to that time and the forerunner of many oil tankers of steadily increasing size as dictated by the economics of the oil industry and the demand for oil for the development of power.

Side by side with merchant ship building Scotts were engaged with the construction of warships, including the battleships "Colossus" in 1910 and the "Ajax" in 1912, the armoured cruiser "Argyll" in 1906, "C" and "D" class cruisers, numerous destroyers, and submarines in the first world war. The latter group included the steam propelled "Swordfish," the prototype of the "K" class submarines. Between the wars cruisers, destroyers and submarines were completed for the Royal Navy, and during the second world war the yard was engaged exclusively on naval work. In the field of engineering the company has played its part as it did in the development of the compound engine, in the development of the turbine, has built Scott-Fiat oil engines for the submarine S.1 in 1912, and builds Scott-Doxford oil engines to-day. The work on the Scott-Still engine, which was a combination of oil engine and steam engine, must not be forgotten; one of them was installed in the Blue Funnel cargo ship "Dolius" in 1924.

The foregoing has briefly outlined the beginnings of Scotts and the subsequent developments under seven generations of the family which is still in possession of Halkshill, near Largs, which was purchased by John Scott (II) in 1810. Throughout its long history Scotts has always been alive to the need to develop and improve and has constantly added land for the expansion of the business or incorporated other firms for that purpose. Trends in shipbuilding and marine engineering have been met and even anticipated by reconstruction and adaption as wooden construction changed to composite and then to iron and finally to steel and riveting was superseded by welding. To-day the accent is still on reconstruction to equip the yard and engine works so that modern techniques may be employed to enable the company to compete in a market which is highly competitive.

Since 1950 work has gone forward steadily with a modernisation plan designed to allow current building programmes to proceed while making preparations to change over to prefabricated construction as opposed to the "plate to plate" system. New sheds have been erected, increased welding facilities made available, and work has gone forward to carry out plans which envisaged reorganisation so that the yard could build tankers up to 40,000 tons deadweight and involved a capital expenditure of £750,000. Our line drawing shows the layout of the yard as it is to-day. As with most yards, boundaries are fixed so that the existing area has had to be utilised to the best advantage, and to make space for storing prefabricated units the original eight berths have been reduced to four. This reduction in the number of berths is in keeping with the building system in which an increased amount of work is performed in the shops so that there is a corresponding reduction of time on the berth. Three of the berths are served by two travelling cranes having lifting capacities of 40 tons at 150ft or 60 tons at 90ft, and our illustration shows a prefabricated superstructure and a 56-ton stern section being placed on the building berth. Ships of 72ft beam can be accommodated on two of the slips which can be combined to take a 40,000-ton tanker of 730ft length overall by 92ft beam. Ships 580ft in length, equivalent to a 24,000-ton tanker, can be built in berth number 3, while the fourth berth, served by two fixed 20-ton cranes, is reserved for Admiralty work.

Limitation of space prevented the adoption of parallel flow of sections and plates when planning the reorganisation, so that the stockyards had to be placed at the eastern and western ends of the yard. From these points the material flows through preparation



One of the bays of the building and prefabrication shed

General view of heavy machine shop

shops to meet up at the welding shed where they are assembled. Sections are shot-blasted and coated as required, and then moved by crane to the working shed for bevelling and shaping into structural members by cold frame benders or, if required, they can be formed hot, a furnace and bending slabs having been retained for this purpose. Plate material is handled by 6-ton magnetic cranes on to conveyors and passes through flattening rolls to a moving table which changes the direction of flow through 90 deg. and moves the plate transversely on to the table feeding the shot-blasting machine, in which both sides of the plate are treated simultaneously, through a further 90 deg. change of direction. In the plate preparation shed, 460ft long by 90ft wide, is a Schican-Monopol twin automatic profile cutting machine, illustrated herewith, which can handle plates up to 40ft long and follows a one-hundredth scale negative produced by a special camera equipment from tenth scale drawings prepared in the mould loft. In addition to this machine, which produces plates quickly and accurately, there are two four-head oxygen flame planing machines, a duplex flame cutter operating from full scale templates, together with other equipment such a rotary shear and plane, flanging machine and sheel rolls. Assembly of sections and plates is carried out in the welding shed which is 360ft long and has two 80ft wide bays, each equipped with two 20-ton overhead cranes to provide a 40-ton lift in each bay. Our illustration shows one of the bays in the welding and prefabrication shed. Bogey transport links the welding shed with the building berths. The 60-ton cranes at the slips permit the maximum of auxiliary machinery to be lifted on board before launch. The fitting out basin opens directly into the channel and is 655ft long by 160ft wide and has 30ft depth of water at low tide. It is served by one 100-ton crane, two 12-ton fixed cranes on the west side and by a 25-ton travelling crane on the east side.

Some £500,000 will have been expended when the reorganisation of the engineering department is completed in 1962. The work began in 1957 and has had to follow a carefully phased programme so as not to cause too great a disturbance of production. Covering about 10 acres of difficult terrain, which caused the various shops to be arranged on three levels cut into a steeply sloping hillside, it has been essential to carry out modifications in strict sequence. One of the handicaps suffered by the works has been the passage of the Glasgow-Gourock railway line through the area, necessitating the use of a private rail system to transport engines and boilers on special battery-propelled bogies to the shipyard. Increasing size of boilers called for a drastic solution of the problem and a new boiler shop is now being built on a plot on the seaward side of the railway and near the ship. It is to be a three bay shop; two bays 200ft long and having spans of 66ft and 82ft respectively have been erected and are in the course of being equipped. This consists of travelling overhead cranes, one of 120 tons and the other of 50-ton lifting capacity already installed, while the items still to be fitted include heavy plate manipulating gear, such as a 100-ton flanging press, a 13ft gap hydraulic plate bending machine for dealing with plates up to 2in thick, and annealing furnaces. The transference of the boiler shop has freed the area previously used for boiler construction and part of this space is to provide a welcome extension to the heavy machine shop of which we include a general view. This will incorporate the two high roof bays of the old shop to form a continuous bay 475ft in length served by 50-ton cranes. The two low roof bays of the old shop are available as parallel extensions to the erecting shop and as a site for the new works boiler, for shop tests, which has been built in the old shop and was its final production. The next phase will be the re-siting of plant in the extended heavy machine shop, and another major item in the reorganisation scheme involves the extension and subsequent re-planning of the copper shop which, together with the welding and light plate shops, will be housed in a three bay structure having a floor area of 54,000 square feet. Meanwhile the policy of the steady renewal of machinery to maintain the shops in an up-to-date condition is being pursued.

Books just published

Business Consortia

124 *pages.*

Publisher : Sweet and Maxwell, Ltd., 11, New Fetter Lane, London, E.C.4. Price 30s.

by A. HARDING BOULTON, LL.B.(Lond.), F.C.I.S.

When a number of companies combine to undertake a specific task, numerous and unexpected problems arise. These problems, which may be legal, economic or administrative, relate to the formation and operation of the joint venture. The book discusses the nature of consortia in general, and deals with the problems most likely to arise with each form. Chapters include; purpose of the consortium, underlying problems, form, documenting, financing of "single project" consortium, management, continuation and future. An index completes the volume.

[Reply Card No. 1210]

Introduction to Transportation Engineering

505 *pages. Illustrations, Diagrams, Maps.*

Publishers : John Wiley and Sons, Inc., 1961. Price 94s.

by WILLIAM W. HAY, B.S., M.S., Ph.D.

This book, which is intended to acquaint the general reader with the basic principles of the subject, deals with the technological principles and problems of transporting both people and goods rather than the design of transport facilities or the economics of transportation. Chapters deal with; transportation's place and function, development and history, transportation systems, physical facilities for transportation, technological characteristics, propulsive force, horsepower and elevation, operating characteristics, terminals, co-ordination, operational control, costs of service, planning and route design and location. There are two appendices on typical transport units, and problem examples. The text is well supplied with references, and each chapter has ten questions for study and a list of further suggested readings. An excellent index completes the volume.

[Reply Card No. 1201]

Shock and Vibration in Linear Systems

415 *pages. Diagrams.*

Publishers : Harper and Brothers, 49, East 33rd Street, New York, 16. 1961. Price 70s.

by PAUL A. GRAFTON, Ph.D.

The author intends this book to give the reader an understanding of the fundamental principles of linear shock and vibration phenomena, and assumes that the reader has a knowledge of elementary differential equations. No prior knowledge of operational calculus or transfer functions is required, for their principles and applications are integrated with the text. The book is divided into three main sections : Part 1—"Fundamental Concepts" contains chapters on complex variables, Fourier analysis, differential equations of motion, transfer function and frequency spectrum. Part 2—"Lumped Parameter Systems with Multiple Degrees of Freedom" is sub-divided into chapters on translational mode of shock and vibration, rotational mode of shock and vibration, branched systems, non-sinusoidal inputs, solution of the frequency equation, shock and vibration isolation by feedback control and Lagrange's equations of motion. Part 3—"Linear Shock and Vibration in Continuous Systems" has sections on wave equations for autonomous systems and their solutions, and force and motion inputs. There are also problems relating to the various chapters, a bibliography and an index.

[Reply Card No. 1202]

Electronic Computer Exhibition

No. I

The second Electronic Computer Exhibition was opened at Olympia, London, on October 3 by Lord Brabazon of Tara, and will continue until October 12. An electronic data processing symposium is being held in conjunction with the exhibition, the final session taking place to-day, October 6, the concluding subject being "New Techniques." A first selection of exhibits is reviewed below.

THE Electronic Computer Exhibition now in progress at Olympia is the second of the series, the first having taken place in 1958. In the intervening three years a new generation of computers has come into being, and much development has taken place in fundamental techniques and in peripheral equipment. Some of the aspects of this many-sided development are seen in the following accounts of exhibitors' displays.

Rank Precision Industries, Ltd.

Demonstrations are given by Rank Precision Industries, Ltd., 37–41, Mortimer Street, London, W.1, of "Xeronic" high-speed computer output printers. Completion of the first production model, to be used with an "Emidec" 2400 computer by the Ministry of Pensions in Newcastle, was reported in our July 28, 1961 issue, page 162. Having no fast-moving parts, the printer is not subject to mechanical limitations on output speed and will produce 2800 lines a minute on a paper web running at a linear speed of 40ft a minute. In the "Xeronic" printer the computer output information appears as characters on the faces of two cathode ray tubes, and is projected on to the electrically-charged selenium film surface of a drum revolving at 10 r.p.m. The charge pattern on the drum is "developed" by cascading a powder over it, then transferred to the paper, and "fixed" by heating as in the normal Xerographic process. After the information has been transferred to the paper, the drum surface passes a discharging lamp, followed by the 600V charging grid. Negatives of form overlays are carried by a roller, or "formhead," and projected on to the drum in correct register with the alpha-numeric information. Both are printed simultaneously so that the output appears on the paper as a completed form with rules, headings, and other permanent information.

Form patterns can be selected by signals fed into the printer with the other input data, causing the formhead to rotate so that the desired form is brought into position for projection on to the drum. Thus several different forms can be printed during a run, in any order, to suit that in which information comes from the computer. Fig. 1 shows the formhead and part of the optical system for projecting information on to the printing drum. Four form patterns are available at present, and a library of thirty-two is in preparation.

Printers are built for on-line and off-line working. Incoming information is read and recognised in the electronic circuits of the equipment, and each character is formed on the face of the tube by up to thirty-five dots. These are produced by the action on the electron beam of deflecting voltages derived from character generators consisting of potentiometer networks on printed circuit cards, which are scanned and activated as necessary for each character by a thirty-five pulse scanner. Each character is formed in turn, and their display on the tube face is slightly staggered to allow for the rotation of the drum at 10 r.p.m., and cause them to appear thereon in horizontal lines. The two cathode ray tubes print on to opposite halves of the paper reel to produce two forms at a time, the paper being cut subsequently. Alternatively printing can take place on one half but not on the other, allowing information to be omitted from preselected positions on either form. Sixteen horizontal tabulation points can be set up by means of plugboard connections. Parity checks are incorporated for error detection, and photo-cells monitoring the faces of the cathode ray tubes cause an alarm to be given if no character appears when one is expected. This is in the form of a flashing light which prints an error symbol on the paper roll. A photocell also monitors the paper cutting and stops the machine when a sheet with an error symbol appears. The faulty sheet will then be at the top of the stack and can be removed.

All electronic circuits of the printer, apart from the photocell amplifiers for tube monitoring, are housed in a cubicle separate from the machine itself. Equipments are to be seen at the exhibition both on the Rank stand and that of Associated Electrical Industries, Ltd., where one is working in conjunction with an A.E.I. 1010 computer.

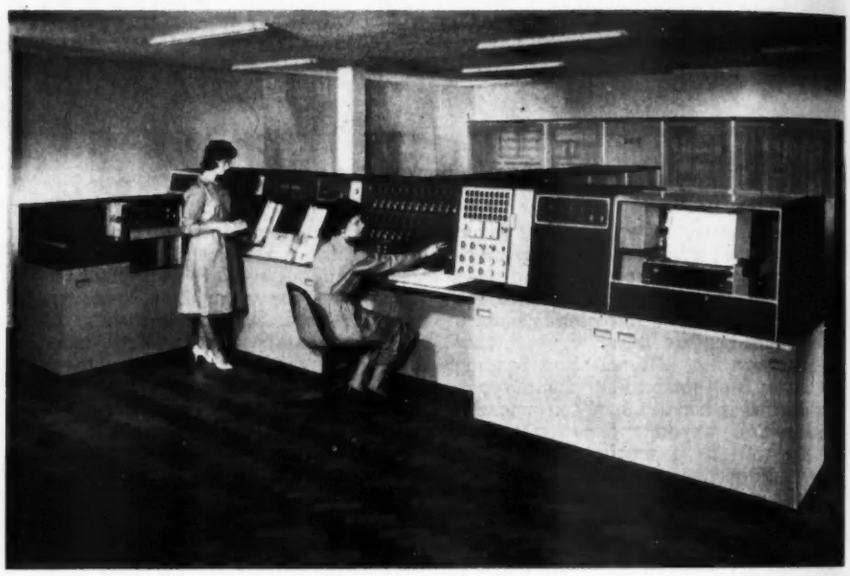


Fig. 2—Control console and input/output equipment of "1301" data processing system, with storage cubicles in background—I.C.T.

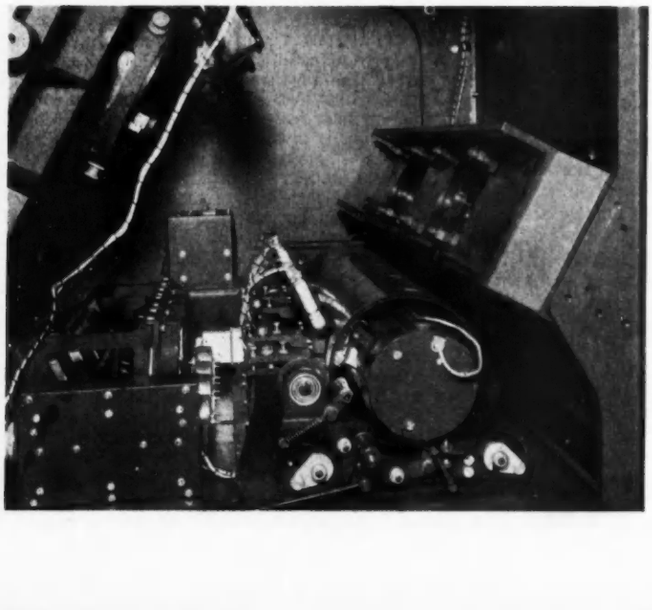


Fig. 1—Interior of "Xeronic" printer, showing formhead roller in centre, with photocell units scanning the character-writing cathode ray tubes seen to the left. Their displays are projected via the optical system (right) to the Xerographic drum in a lower compartment—Rank Precision Industries

International Computers and Tabulators, Ltd.

The 1301 electronic data processing system of International Computers and Tabulators, Ltd., 149, Park Lane, London, W.1, is being shown publicly for the first time. This installation, of which we gave preliminary details in our June 3, 1960 issue, has been designed to allow for easy expansion on site of the basic layout seen in Fig. 2. The standard machine processes information from punched cards, with photo-electric reading,

but on-site expansion, including additions to immediate access core storage, drum storage, and magnetic tape input and output units, can greatly increase the computing capacity. Two magnetic tape systems are available—the standard system (½in tape operating at 22,500 digits per second) and the high-speed system (1in tape operating at 90,000 digits per second). Provision is made in the card input for selected cards to be segregated automatically after they have been scanned.

Production of this computer has awaited the availability of transistors capable of operating continuously and reliably at high switching speeds. Cycle time is 1 Mc/s, and this high internal pulse rate is utilised fully to enable all units to function simultaneously under the control of the programme, thus saving the cost of buffer storage.

Referring to Fig. 2, the all-transistor arithmetic unit, operating at a theoretical speed of 38,000 additions per second, is behind and at right angles to the console, connecting with the storage cubicles at the rear. These contain the immediate access core store and the drum store. Modular construction allows immediate access capacity to be expanded in steps of 400 words from 400 to 2000 words, and drum storage to be increased from one to eight units. Input information goes mainly into the drum store (12,000 words capacity) but selected items can be put at once into the immediate access store. The drum rotates at about 5000 r.p.m., and economy in access time is achieved by the facility for transferring a channel of information so as to start at any one of twenty different positions around the drum circumference.

The high-speed output printer at the right of the illustration operates at up to six hundred lines a minute. Characters are carried on a drum revolving at 800 r.p.m. The moving paper is struck from the rear by hammers operating to give a contact time with the drum characters of 1½ milliseconds. Lines are assembled character by character, the impression at any instant consisting of one or more similar characters which are caused to appear in their correct relative positions along the line by selection of the appropriate hammers. A punched card output operating at 100 cards per minute is also provided. All connections between electronic units of the computer are made by wrapped joints, plugs and sockets being eliminated.

The company is also exhibiting its 1202 computer, and an I.C.T. subsidiary, the Data Recording Instrument Company, Ltd., is showing digital tape transports, and a tape testing equipment.

Fig. 3—General-purpose KDN2 computer, showing "Datapac" logic elements in cubicle on left—English Electric

The English Electric Company, Ltd.

We illustrate in Fig. 3 the KDN2 small-scale general purpose computer shown by The English Electric Company, Ltd., English Electric House, Strand, London, W.C.2. As reported briefly in our September 22 issue, the KDN2 logical circuitry is built up with "Datapacs." Each "Datapac" element consists of two small printed circuit boards mounted back to back in a moulded red nylon frame which forms two sides and one end of the assembly. The end is shaped to form a handle which carries a label identifying the function of the package, and the other end is formed by a multi-terminal plug block. Transistors and other miniature components for each element are mounted on the two printed circuit boards and all incoming and outgoing connections are made to the plug block. This has corrosion-proof gold-plated sprung leaf connections to ensure free flow of low-level signals.

All "Datapacs" are of standard shape and size and are designed to slide side-by-side into specially-constructed bins which are mounted in unitised cubicles. One such cubicle, seen on the left of Fig. 3, is used in the KDN2, housing 252 "Datapacs" in nine tier-mounted bins. The "Datapacs" and bins are mechanically coded for correct location, and a spring-loaded automatic locking bar common to all the "Datapacs" in a bin ensures that they are pressed fully home and are held firmly in position.

A basic KDN2 installation as illustrated comprises only three units: a cubicle containing the transistor-driven ferrite core high-speed store, "Datapac" logical circuitry, and various power supply units; a control desk on which are mounted the paper tape read and punch units and a control panel; and a small cabinet supporting the electric typewriter and housing its associated power supplies and control circuitry. Auxiliary magnetic tape storage units can be added if required. In certain instances, particularly for on-line applications, the control desk and typewriter cabinet can be dispensed with.

The real time, as distinct from general computing, applications of the KDN2 system fall under the headings of data logging and process control. Applied, for example, to the monitoring of variables in steam power plant, the system could handle boiler pressures, flow rates and temperatures and water levels, providing logging, storage and high-speed computation facilities, and working if required in conjunction with an alarm or display system. In process control work the computer receives information about the process, analyses it, and as a result determines and initiates any control measure or sequence of control measures necessary. Into this category falls the majority of industrial applications for which KDN2 is suitable, such as the automatic control of machine tools in a factory, the control and optimisation of operation in a steel mill, and the control of equipment operation in a power station or engine room.

The Plessey Company, Ltd.

Exhibits of The Plessey Company, Ltd., Ilford, Essex, are contributed by the Electronic and Equipment Group, and the Components Group. Research into high-speed storage systems by the former is represented by a system using tunnel diodes (Fig. 4) which has a read/write cycle time of fifty nanoseconds. The system uses tunnel diodes as storage elements, and will be constructed in self-contained modules having

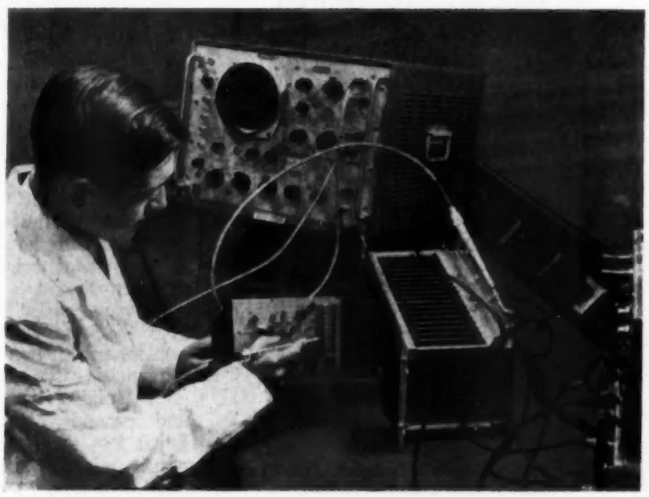


Fig. 4—Experimental store using tunnel diodes—Plessey

a basic printed board containing sixteen bits per word, the arrangement providing flexibility for designers of logic systems. A new equipment under development is a 400-million bit random access magnetic store in which magnetic oxide coated discs are used as the storage medium. The store is of large capacity and small volume, and has an access time of 200 milliseconds.

In these computer storage applications the characteristic of the tunnel diode which is made use of is not its negative resistance, but its bistable property. With suitable bias, one of these elements can form a flip-flop circuit which is switched from one state to the other by current pulses. For example, it may be arranged that two simultaneous inputs are needed for a change of state. If an output is then given to two loads, the circuit will remain in its new state, but the additional current taken by a third load will switch it back again.

The feasibility of replacing semiconductor logical and counting circuits in computers by ferrite equivalents is illustrated by a display of multi-aperture devices. Substantial increases in overall reliability are claimed for these shaped ferrite parts. Although this field of development is in its early stages, considerable interest has already been shown in multi-aperture transfluxors, and a shift register using these is demonstrated.

MULLARD, LTD.

Representing the work of its Electronic Component Division in developing the mass production of micro-circuits with component packing densities of 300 to 400 per cubic inch, Mullard, Ltd., Mullard House, Torrington Place, London, W.C.1, is showing a multivibrator, an adder and a shift register of this form. We illustrate in Fig. 6 (upper) the 100 kc/s shift register containing two transistors, six diodes, ten resistors and four capacitors on a 2cm by 1½cm substrate. The lower view shows a multivibrator using two transistors, three resistors and two capacitors on a substrate measuring approximately 3cm by 2cm. Both views are approximately actual size. The circuits are produced by a process of evaporation under high vacuum, in which all the components (except the semiconductor devices) are deposited on small glass substrates about $\frac{1}{32}$in thick. Nichrome is used for the resistors and gold for the conductors; the capacitors are formed from silicone monoxide between areas of aluminium.

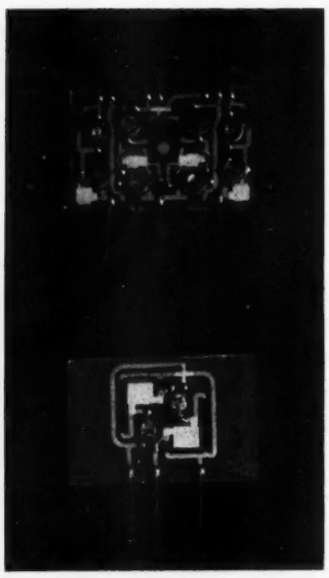


Fig. 6—Micro-miniature shift register (above) and multivibrator (below)—Mullard

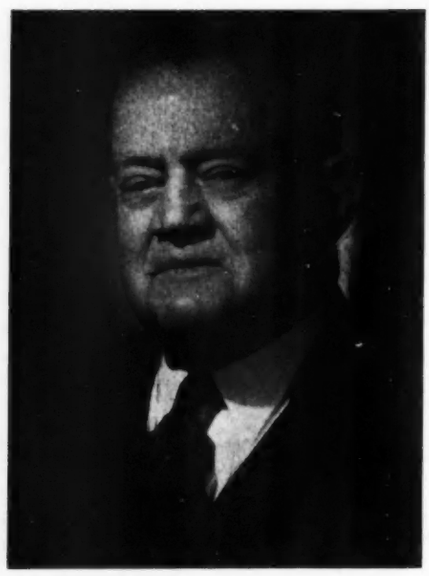
Two of five working demonstrations by the company's Semiconductor Division are a transistorised adding machine and a desk calculator. These experimental models have been made to demonstrate to the computer designer that the use of semiconductors in small computing machines is already economically practical, and that such machines possess advantages over electro-mechanical equipments in reliability, maintenance-free service, and silence of operation. Three separate working circuits designed for use in modern computers are also shown, one of them being a high-speed logic circuit with thirty outputs.

(To be continued)

Obituary

ESSINGTON LEWIS, C.H.

IT is not easy to judge whether Mr. Essington Lewis, C.H., who died at Melbourne on Monday at the age of eighty, will be best remembered for his remarkable services to that great Australian industrial concern, the Broken Hill Proprietary Company, Ltd., or as a great empire builder. Truly it may be said that his life was a close parallel to that of the company itself. His grandfather, Mr. James Lewis, started the connection, not by founding the company but, as a member of an expedition exploring the central Australian desert in 1844, by discovering Broken Hill. Two years after



Essington Lewis, C.H.

Essington Lewis was born at Burra in South Australia, valuable deposits of silver and lead were found at Broken Hill which led to the formation of the present company in 1885. It was thus natural that a lad who, after trying his hand at cattle ranching and the law, was determined to become a mining engineer should seek employment at the hill discovered by his grandfather. By that time the company was already using the ironstone from two hills in the Spencer Gulf for smelting the silver-lead ores of Broken Hill. Joining the company in 1903 as an underground worker for 5s. a day, Essington Lewis was soon made foreman of the sulphuric acid and zinc plants and a few years later promoted to assistant manager of the smelting plant at Port Pirie in which B.H.P. made its first pig iron.

It was not until 1915 when the company began producing steel at Newcastle that he was to have full scope for his technical, administrative and financial ability. The Spencer Gulf iron ore was taken by ship to Newcastle, where there was plenty of coal and a river estuary, and he at once saw the need for the company to buy its own collieries and ships if it was to become one of the largest steel producers in the British Commonwealth.

He was made general manager of the company in 1921 and managing director five years later, a position which he held until 1938, when he became chief general manager. By then, as the result of his initiative and drive, the company at Whyalla had dredged a deepwater harbour and constructed a shipbuilding yard—now the largest in Australia—with the primary aim of building its own steamers for the transport of ore. Indeed, since its amalgamation with Australian Iron and Steel, Ltd., in 1935, the Broken Hill Proprietary Group has become an association of several companies and has spent millions of pounds in developing its steel plants at Newcastle and nearby Port Kembla to reach its present production of nearly 3,000,000 tons a year.

In 1938 the Australian Government appointed Essington Lewis chairman of its advisory panel on industrial organisation and business consultant to the Defence Department. In May, 1940, he was appointed director-general of munitions with special powers; he advised that Australia was in a position to respond to the British Government's request that she should build corvettes, frigates, and other anti-submarine craft. Having already before the war established a shell-producing annexe to the B.H.P.'s main steel plant at Newcastle, he promptly set about increasing his country's production of munitions. By 1943 he had increased the number of Government munition factories from four to forty-eight and had created 213 munitions annexes in private companies. Australia was indeed by then largely self-sufficient in munitions and was providing them also for her allies in the south-west Pacific. A year after his appointment as director-general of munitions, he was also made director-general of aircraft production and in these two capacities he was mainly responsible for ensuring that industry was mobilised to achieve the maximum effort in support of Australia's fighting forces. For his great services in the war he was created a Companion of Honour.

DR. CHARLES CORNFIELD GARRARD

WE have learned with regret of the death on September 21, of Dr. Charles Cornfield Garrard, a former director of The General Electric Company, Ltd. Dr. Garrard was well known as an authority on electrical switchgear and one of the pioneers of the heavy electrical industry in this country. Born in 1877, he was educated at the Central Foundation Schools of London, Finsbury Technical College, and the University of Gottingen, where he became an assistant to Professor Nernst. On returning to England he was appointed engineer to the Nernst Electric Light Company in London and later joined Ferranti, Ltd. Dr. Garrard joined The General Electric Company, Ltd., as manager of the switch and controller works at Witton in 1908, and in 1928 also took charge of the transformer works. In 1942 he became joint general manager of the Witton Group of engineering works and was elected a director of the G.E.C. a year later.

International Conference on Heating Ventilating and Air Conditioning

ASSOCIATED with the international exhibition being held in Olympia is an international conference on Heating, Ventilating and Air Conditioning which is under the patronage of H.R.H. The Duke of Edinburgh and has been organised by The Institution of Heating and Ventilating Engineers in co-operation with The Association of Heating, Ventilating and Domestic Engineering Employers and The Heating and Ventilating Research Association.

The conference was based on three themes, namely: administrative advances likely in the next ten years concerning which seven papers were read; technical advances likely in the next ten years, upon which thirteen papers were presented; and integrated design of architectural and engineering services for economy of building construction, eight papers being read on various aspects of this subject.

Lord Mills, Paymaster General to Her Majesty's Government, inaugurated the Conference on the morning of Wednesday, September 27. In the course of his remarks he said that heating engineers were increasingly able to achieve, a greater efficiency, a higher standard of comfort without labour and to build houses free from dust, smoke and grit. Towards this end the Institution had helped ever since it was formed before the turn of the century. All fuels were used now more efficiently and great changes in conditions in factories and homes had taken place, but there remained too many buildings which were poorly heated and lighted. The Clean Air Act of 1956 had helped progress as had the Act setting a standard of insulation against loss of heat. There was room, he continued, for the provision of improved air conditioning when planning buildings.

Dr. F. M. H. Taylor, the President of the Institution of Heating and Ventilating Engineers, then gave his presidential address which reviewed past achievements, considered the future, examined the growth of turnover, trends in fuel supplies, and the future needs for technologists. It gave thought to: new applications for heating and air conditioning, revenue for research, prefabricated and packaged equipment and standards of performance.

An abstract of the address appears below.

Presidential Address

As an industry we have set as our task the provision of conditions internally in the buildings of our cities, and countryside, that will compare favourably with that in the health resorts in Switzerland and Bermuda. This means closely controlled conditions of temperature, humidity, radiant heat, air movement, cleanliness, absence of noise, reduction of bacteria content, and possibly the optimum concentration of negative ions.

Our Institution played a significant part in presenting information leading a few years ago to the passing of Thermal Insulation and Clean Air Acts. Smoke and dust control would not have been possible without suitable equipment to burn fuel smokelessly. The design and installation of this equipment has been the responsibility of our members.

The heating and ventilating engineer's work is now no longer confined to the primary theory and technology of the subject, nor even to the practical engineering, but to the wider field of economics, administration, organisation and perhaps in the future the study of human behaviours insofar as organisational efficiency needs the right man, in the right job, with the right environment.

Heating, ventilating and air conditioning uses applied physics in heat transfer and fluid flow, chemistry in combustion, corrosion and water treatment, physiology and psychology in human reactions to environmental conditions, biology in control of organisms (beneficial or harmful) present in the atmosphere we breathe.

One of the main contributions to the reduction of road accidents is the heating of roads at inclines or at cross-roads to remove snow and ice.

Air conditioning will be used increasingly for the preparation of pigs and cattle and other livestock for human consumption. Controlled atmospheric temperature and humidity is now a necessity for cheese making and ripening.

Special air conditioning problems will be faced in the future which includes the conditioning of high speed, high altitude aircraft, nuclear-powered underwater vessels and by the late 1960's space vessels, satellite stations and probably within our own lifetime the export of an atmosphere to the moon and possibly to the planets. The development of regenerative air conditioning will not have its use confined to space ships, but should find applications in underground establishments, gasproof telephone exchanges and operation rooms, and processes involving radioactive materials.

Increased demand for electricity indicates development of heat storage appliances with controlled heat release as with a fan circulated system; and the adaptation of the heat pump for heating, cooling and dehumification. Dehumidification for occupied premises, coupled with the development of packaged heat pump installations, open up possibilities for air conditioning with low energy consumption and thus low running costs. The discomfort in home, office and factory associated with high humidity need no longer be tolerated with the availability of simple and relatively inexpensive dehumidification equipment.

Whatever developments are made in the future to the improvement of mankind's health, vigour and longevity, controlled environment will assuredly play an important part, as indeed it will if, in the forseeable future, man learns how to control the evolutionary changes in the characteristics of the human race.

One of our first considerations should be to endeavour to assess the economics of fuel supply as it will be in the later 1960's and early 1970's. The pattern of change in fuel economics is such that it is our duty to ensure that equipment and installations are available to make use of the fuels that will be economically most efficient in utilisation, having regard not only to unit cost but also to such matters as availability, economics of distribution, usage load factor and atmospheric pollution which should not only take account of visible smoke but also of the release of sulphur products into the atmosphere.

The foundation of Britain's industrial success up to the early part of this century was based on cheap and abundant fuel. We thus tended to lag behind overseas countries (where fuel prices were higher) in the design of heat generating and distribution equipment, which laid emphasis on fuel economy. This position has changed. As an example, industrial gas in Great Britain is 15·75d. per therm, whereas in the U.S.A. it is 2d. to 3d. per therm, and natural gas from Italy or possibly from the Sahara or from Holland may shortly be made available for many parts of the Continent of Europe at between 3d. and 4d. per therm. Coal in Britain cost 103s. per ton for industrial use, but on the eastern seaboard of America it is 70s. per ton. Solid fuel costs in Germany have begun to show a downward trend in prices. Fuel oil in Britain costs £10 per ton and in many countries in Western Europe it is £5 per ton.

The heating and ventilating engineer is responsible for the design and installation of plant using nearly one-half of the nation's total energy consumption. The work we do to-day provides a captive customer for one or other of the fuel suppliers for the next ten years or more. We are handicapped by the limitations of our present national fuel policy. We are entitled to ask that artificial insulation of monopolistic fuel suppliers from the blasts of competition from alternative fuels, whether produced at home, or imported, should be reviewed and eventually terminated.

If taxation is to be imposed on any fuels or fuel consuming equipment, the amount might well be influenced by the damage caused by smoke and sulphur emission, thus encouraging the elimination of these evils in our densely populated areas. Sudden changes in fuel prices caused by taxation changes and fluctuation in purchase tax on fuel conversion appliances should be avoided as causing a distortion of the economics of an installation and preventing the long term planning of the design and production of heating or cooling equipment.

There seems no good reason why heating and ventilating should not have at least an equal expenditure to that of other technologies. There is abundant evidence that our allocation for research and development at the present time falls far short of the nation's average and should be increased several times over the next five years. The optimum use of the equipment installed by heating and ventilating engineers depends on public appreciation of its performance and its operation. We need a campaign very similar to that for sanitation many years ago and—more recently—hygienic food control. Those responsible for laying down the environmental standards for both office and factory workers are often inhibited through the lack of knowledge of the equipment and the technologies which, in fact, are available.

The recently published central heating booklet—a best seller for the first time—gives heating in the home a technological background with guidance to the installer and to the user, that is, the public at large.

Already other engineering institutions realise that the great importance of the technologist in economic growth justifies his natural demand for a voice in those larger national issues which can harness or frustrate his endeavours to benefit his fellow citizens.

We can learn from our Continental friends where investment on which technological advance depends is given greater incentive and is thus higher than in the United Kingdom; where public capital projects are carefully screened thus reducing if not eliminating those giving an inadequate economic return; and where also fiscal policy encourages rather than discourages advanced designs with the objective of saving labour.

International Heating, Ventilating and Air Conditioning Exhibition

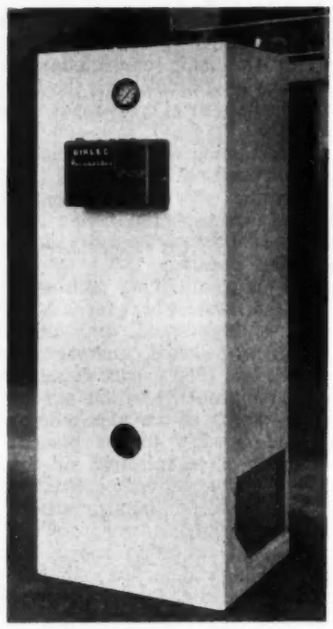
No. I

ON Tuesday, September 26, Mr. C. J. Atkins, the Chairman of Exhibition Committee, formally opened the International Heating, Ventilating and Air Conditioning Exhibition which is the first of its size to be held in Europe. The exhibition which closes to-day October 6, is being held in the Empire Hall, Olympia, London and has been promoted by an advisory committee of the industry and sponsored by The Institution of Heating and Ventilating Engineers. In his opening remarks Mr. C. J. Atkins said that the exhibition opens at a time when the industry is rapidly expanding and when the importance of clean air related to health is being stressed.

In addition to equipment usually associated with the title there is on view industrial air treatment and handling plant and ancillaries thus indicating that the exhibits are concerned with factory working conditions, atmospheric pollution, and clean air and so is of direct interest to the industrialist. The latest technical advances are on view, including those which improve fuel economy and affect the basic economy of the country. Mr Atkins quoted Board of Trade figures which gave the value of the output of the industry for 1958 as £30,000,000 and estimated that the 1961 return would be about £50,000,000.

The exhibition covers an area of more than 100,000 square feet on the ground, first and seconds floors of the Empire Hall and above 220 firms from this country and abroad are exhibiting products which relate to all aspects of heating, ventilating and air conditioning for domestic and industrial purposes.

A number of new items are shown on the stand of A.E.I.-Birlec, Ltd., including the " Frescon " which is a compact and self contained air treatment unit. There are six units covering tons of refrigeration range from 3·3 to 19·0 and our illustration is of a mark RU7·5 machine which has a motor of 7·5 h.p., a fan of 1·5 h.p. and 3000 cubic feet per minute capacity, a tons of refrigeration capacity of 7·2 and cooling water requirements of 6·5 gallons per minute and is able to deal with a space of 30,000 cubic feet to maintain comfortable conditions. The cabinet is divided into sections and the air is drawn into the middle section, passed through a refrigerated element where the drop in temperature condenses the excess moisture in the air which is then discharged back to the room through the top grill. Also on the stand is a mark BZ60 " Autosorber," illustrated herewith, representative of a range of six for



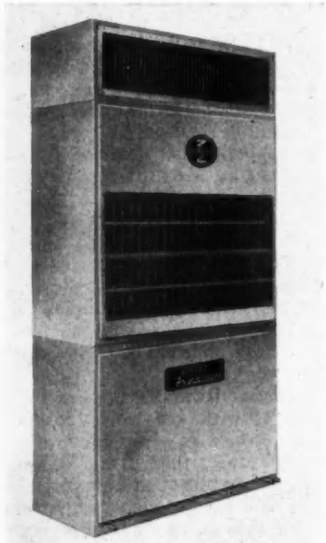
Mark BZ60 " Autosorber "

treating compressed air and other gases and having a standard flow rating, based on inlet gas at 100 lb per square inch saturated at 80 deg. Fah., ranging from 50 to 1800 saturated cubic feet per minute and the heater ratings rising from 3 to 45kW. The " Autosorbers " consist of two vessels, charged with an adsorbent material suitable for the required duty, and through it the gas is passed as controlled by an automatically operated changeover valve. A heater is fitted to each vessel and this is automatically brought into operation to reactivate the absorbent when the vessel is off stream. Heating, cooling and changeover cycles are time controlled and a small flow of gas is passed through the off stream vessel to purge out the moisture generated during reactivation and to expedite cooling. For the solution of laboratory and allied problems, there is a smaller unit available and this is the " Minisorber " in which the gas to be treated passes through a bed of granular adsorbent material within the vessel. When the dessicant has reached its capacity limit it can be reactivated by heating while a purge flow of gas is passed through it and this cycle can be repeated thousands of times. The inlet and outlet cocks are suitable for handling hydrogen at up to 100 lb per square inch and there is a flow meter for setting up the purge flow.

One of the items on the stand of Tilghman's, Ltd., is a quarter scale model of one of the company's N.T. fabric filter dust collectors. The size 70 group has a filter area ranging from 340 to 1360 square feet and the size 126 group a filter area of 650 to 2500 square feet. It is claimed that with these collectors that there is normally no visible discharge even with sub-micron size particles and that the collecting efficiency is over 99·8 per cent. A full range of fabrics, including silicone treated fibre glass, is available so that gas temperatures up to 500 deg. Fah. (closed type) or 650 deg. Fah. (open type) can be handled. The filter tubes are suspended from simple rocker bars which are operated by an externally mounted power unit while rubber bounded bearings ensure quietness in action. A hinged access door gives access to the full length internal inspection walkway.

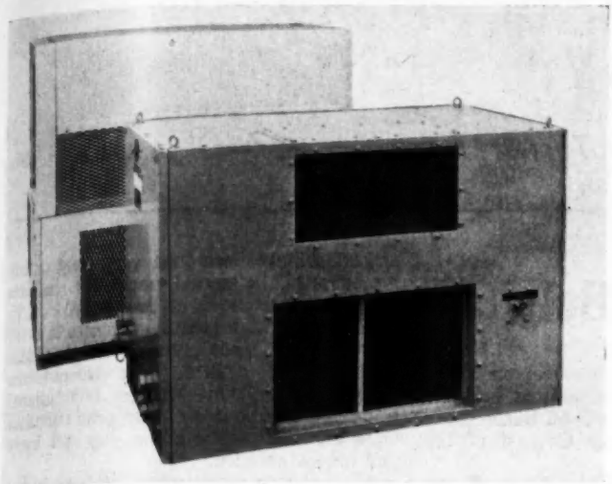
In addition to three models of its Thermobloc heating units the Wanson Company, Ltd., has on view a package steam generator the " Vaporax " which operates on the water injection principle, and is designed to augment existing steam supplies. Two models are available namely the " 100 " having a steam output of 220 lb per hour at 80 lb per square inch gauge, which we illustrate, and the " 300 " with an output of 660 lb per hour at 120 lb per square inch gauge. These two compact units can deliver steam at operating pressure in two minutes from cold; they have a coil pattern combustion chamber. Before use the water is treated in a water softener and then is injected into the coil, which is designed so that soot deposits are prevented from accumulating on its surface, so that heat transfer efficiency is maintained. An efficient steam separator ensures that the dryness fraction of steam is between 0·98 and 0·99. Less than 6 gallons of water are contained in the coil and safety controls provide for flame failure, lack of water flow, and include high temperature cut off and pressure release valve.

On the stand of Lancaster and Tonge, Ltd., is the company's " Dyna-Trap " which is a thermodynamic steam trap which has only one main moving part, the piston. The valve consists of a stainless steel ball working on a seat of the same material, and both components can be replaced without removing the trap. The unit operates by detecting the alteration in pressure which occurs in a passage in the trap when the flow changes from water to steam. When discharging cool condensate the water under pressure forces the ball valve off its seat and flows through an annular space between the inside of the piston and the outside of the seating and then out of



" Frescon " Mark RU7·5 air treatment unit

Package steam generator " Vaporax " 100



5-ton packaged air conditioning unit

the trap. The space beyond the ball valve is connected to the space above the piston through a non-return valve and when steam arrives it expands after passing the ball valve so that the volume to pass the annular space is greater than that which passed the ball valve. The pressure in the space and thus in the cylinder is greater than when condensate was flowing so that the piston moves downwards to further restrict the annular space and the resulting pressure rise forces the ball valve on to its seat. The piston remains down until the steam pressure in the space above the piston is reduced when the valve opens and the cycle is repeated. With condensate at 10 deg. Fah. below steam temperature and the surrounding air temperature at about 70 deg. Fah. the " Dyna-Trap " continuous flow discharge rate ranges from 290 lb per hour at 5 lb per square inch at the trap to 470 lb per hour at 300 lb per square inch pressure. Another exhibit is " The Lancaster " fluid ring expansion joint which consists of a fixed tube with a precision ground bore, and is mounted on a bracket which forms an anchor base, and an internal steel sliding tube carrying two sets of piston rings. A split stop plate limits the travel of the sliding member and the gland is sealed by packing the annular space between the two sets of piston rings with a high viscosity fluid which acts as a lubricant. A small cylinder fitted with a screwed plunger is mounted on the fixed tube and is used for repacking the gland, the packing being forced into the gland through a non-return valve by giving the plunger a few turns. The expansion joint is suitable for use with pressures up to 500 lb per square inch and temperatures up to 550 deg. Fah. and is available in bore sizes from 1½in to 12in.

A representative selection of the company's products for air movement and heating is shown by Woods of Colchester, Ltd., and of particular interest is the demonstration of silencers for aerofoil fans. These silencers achieve a substantial reduction in sound level and consist of a cylinder, presenting negligible resistance to air flow, with an interior surface of perforated steel lined with an inorganic fibrous sound absorbent, rot and fireproof material. The design provides for maximum attenuation at those frequencies where the fan sound is loudest and where the ear is most sensitive. To obtain full sound absorption the silencer must be mounted adjacent to the fan: one silencer will reduce the sound level by about 10dB while two in series will give a reduction of 15dB. Eight sizes are available to match "Aerofoil" fan sizes from 12in to 60in. Also exhibited is a gas fired air heater, operating on bottled commercial propane, which provides heated air for drying out new buildings or flooded buildings, or for warming up engines, or passenger vehicles or providing hot air for crop drying or industrial drying processes. The heater consists of a cylindrical casing in which a gas flame burns in an air stream and the double nozzle burner ensures a stable flame and complete combustion so that the total calorific value of the gas is transmitted to the air. A 19in "Aerofoil" fan is mounted within the heater casing and the air is delivered through a 15in diameter single duct or through two, three or four duct outlets. The commercial propane gas has a calorific value of 2450 B.Th.U. per cubic foot and the consumption at maximum output is 200 cubic feet per hour.

Besides having on view an example of the " Dalamatic " automatic fabric filter which was described in THE ENGINEER of September 29, Dallow Lambert and Co., Ltd., showed three of its " Unimaster " dust control units. Special components are incorporated in those designed to handle Dealpon, a material which poses a possible explosion hazard and tends to arch in the hopper. The latter tendency is overcome by means of a hand-operated cranked lever fitted in the top of the hopper while to deal with the former there is an extended explosion relief duct. The outstanding items of the new " Unimaster " units are : a one piece fabric pad filter which facilitates laundering and provides for economical renewal; motorised air cushion filter cleaner of greater power ; a " Fulimatic " cleaner sequence control panel ; an increased range of difficult dusts which can be handled ; and a quick release bin sealing mechanism.

A wide selection of components and assemblies are shown on the stand of the Lightfoot Refrigeration Company, Ltd., including two examples of improved packaged water chillers which incorporate a new evaporator having non-corrosive qualities which make the units suitable for cooling brine, oil and other liquids. The first of a new range of high speed Semi-Hermetic " Frein " compressors mark S.H.F.26, is displayed and has an operating speed of 1450 r.p.m. and is available in a 10 to 20 h.p. range. Also on view is a 5 ton packaged air conditioning unit, illustrated herewith, the smallest of a newly developed range with capacities of 5, 8, 13 and 20 tons. Each unit consists of condenser, compressor and air handling sections which, except for the 20 ton unit, can be combined into assemblies. The compressors used are of the company's four-cylinder " V," or six-cylinder " W " pattern and are driven either direct or through Vee belts by enclosed squirrel-cage motors. A welded steel receiver holds the full charge of refrigerant. In the condenser section the air cooled models have two propeller fans driven by squirrel-cage motors to promote air flow across the condenser coils while the water cooled models have shell and tube pattern multi-pass condensers. The design of the air handling section provides for ducted distribution and for either top or side delivery. Air circulation is effected by two double inlet, double width, centrifugal fans mounted on a common shaft and belt driven by an enclosed squirrel-cage motor. Return air passes through a viscous filter and a viscous filter and air trap are fitted to the fresh air intake.

(*To be continued*)

Technical Reports

Formgebung technischer Erzeugnisse. VDI Handbook No. 2224 (Design). Düsseldorf : VDI-Verlag G.m.b.H., Düsseldorf, Bongardstrasse 3. Obtainable from Beuth-Vertrieb G.m.b.H., Berlin, W.15, Uhlandstrasse 175. Price DM.4.80.—The advisory booklet " Shape and Form of Technical Products—Recommendations for the Designer " was compiled by the Joint Committee on Design of the Verein Deutscher Ingenieure (VDI) and the Verein Deutscher Maschinenbau-Anstalten (VDMA). The committee has aimed at laying down generally acceptable practical rules for the styling of industrial products. While admitting that there is no valid definition of beauty, the authors state as an axiom that the functional soundness of a design is a necessary, but not a sufficient, condition of its aesthetic appeal. Analysing the problem further, they conclude that the form of a beautiful technical product must clearly correspond to its function and to the materials of construction. Technical shapes are to be explicitly functional and unobstrusive. Stylisation as an end in itself is to be avoided. Components are to be combined in the best possible manner in the least possible space, in a well-proportioned arrangement which gives the impression of forming a unity. In general, large restful areas are desirable, and a feeling of balance should prevail. The shapes of all parts should be related among themselves and with the whole ; necessary joints are not to be suppressed or covered up, but should be used as structure-creating elements. Repeating parts should be of the same shape and grouped in a clear manner. Ornamental strips and edgings without technical function should be avoided. The use of one, or more than one, colour is admissible but must harmonise with the shape and formation of the product. These theses are further developed on the basis of illustrations drawn from recent practice and covering a wide range of engineering design. Although admittedly the booklet does no more than graze the surface of a range of very thorny problems, it could undoubtedly help many designers to clarify their minds on what is involved in " good design." It is to be hoped that it will be widely studied.

Thermodynamic Method of Measuring Turbine Efficiency—Further Measurements on Low- and High-Head Turbines. (Fluids Report No. 93.) By A. S. Thom, A.M.I.C.E., and D. N. Singh, Ph.D. Department of Scientific and Industrial Research National Engineering Laboratory, East Kilbride, Glasgow. No price quoted.—Earlier tests, using measurements of the temperature rise of the water flowing through a turbine to determine its hydraulic efficiency, have been extended to include tests on low-head (100ft and 190ft approximately) and high-head (1275ft approximately) power stations.

In the low-head tests large changes in water temperature, more than 0·001 deg. Cent. per minute, affected the measurements adversely, since the temperature rise to be detected is very small. Further tests are planned to improve accuracy of measurement on this type of installation.

By-passing the cooling water at the high-head station at Finlarig gave much more consistent results. Subsequent examination showed that hot air intakes into the turbine casing should be closed to avoid a systematic bias in the results.

Sustained Load Strength of Timber. By H. Tottenham, M.A., Timber Development Research Association (Research Report E/RR/11). Price 3s. 6d.—In this report timber is considered as an ideal viscous elastic medium. Various criteria for breakdown are considered and the Coulomb hypothesis, that breakdown occurs when a critical strain is reached, is found to be in agreement with present experimental data. On the basis of this hypothesis, the author of the paper suggests a rapid method of determining the sustained load strength of timber.

MAINLY METALLURGY

by T. Henry Turner, M.I.Mech.E. M.I.Loco.E. A.R.Ae.S. F.I.M.

Non-Ferrous Metallurgists in Belgium

BY invitation of the Union des Industries de Metaux Non-Ferreux, the Institute of Metals held its fifty-third Autumn Meeting in Brussels on September 18-22, 1961. Three technical sessions were organised to start at 10 a.m. in the Palais des Congrès, Coudenberg ; their themes being respectively (1) " Deformation and Fracture " ; (2) " Surface Friction and Lubrication in Metal Working " ; and (3) " Corrosion."

A member attending a scientific discussion without a preprint in his hands is like an amateur watching a game rather than the keen participator that he should be. It is therefore worth recalling that in the early days of the Institute all the members attending the autumn meeting were provided with a complete set of octavo preprints. These were a most valuable source of information to those who later stored them in pamphlet boxes, appropriately sorted under their subject headings. Nowadays the printing of the Institute's scientific papers is well done in the larger quarto size, but preprints do not automatically come to all registered as attending the meetings. Consequently, one searches for those of the papers that have already been printed in recent issues of the Journal. For this meeting in Brussels one should have taken no less than eight issues of the Journal, 4 lb weight of paper, and three as yet unpublished preprints in order to follow the technical discussions. Sessions (2) and (3) were held simultaneously so anyone could only follow two out of the three sessions ; even so the weight of paper to be taken abroad to this meeting must have caused many of those, not primarily intending to take part in the discussions, to arrive at the meetings without the appropriate and indeed essential preprints. This practice as regards preprints has also had to be adopted by the Iron and Steel Institute and it results in limiting the speakers to the relatively few experts in the various fields. However pleasing that may be to them it is not all gain because the senior industrialists and the academic members of college or university teaching staffs must take a wider view of all these subjects. In the earlier days such elder statesmen rose more often to take part in the discussions, and they helped to place the complexities of detail in perspective against the wider backgrounds of commerce and science.

The Non-Ferrous Metals Industry in a Unified Europe

The Autumn Lecture to the Institute of Metals was delivered by Baron Snoy et d'Oppuers, in the Palais des Congrès, Coudenberg, Brussels, on Monday, September 18th, and it could hardly have been more topical or authoritative. The lecturer was one of the principal negotiators of the Rome Treaty on the Common Market and Euratom. From 1939-60 he was Permanent Secretary to the Belgian Ministry of Economic Affairs. From 1948-50 he was chairman of the O.E.E.C. Council and he has been chairman of its Steering Board's committee since its creation in 1952 ; from 1944-60 Baron Snoy was also chairman of the Council of the Benelux Union.

The news from the Congo shows all too clearly that the prospects of the extensive mining and metal extraction industries in Katanga are problematical. Unfortunately, it seems certain that for the immediate future the world will lose the benefit that should have accrued from the copper, cobalt and other metals that had been prospected, extracted, and made available largely through the initiative of the Belgians.

The assumption of a unified Europe, said Baron Snoy, is novel to those who clearly remember the pre-war years, 1920-39, when the economic and political divisions of Europe produced an extraordinary pattern of industrial and trade structures. Frontiers between the different countries were then increasingly difficult to pass and internal markets became predominant in the eyes of big business managements. In all the outlets for European industries one found protectionist State intervention, preference and discrimination. Certainly during the late 'thirties strategical and defence considerations dominated the minds of politicians and others who had to make decisions. Despite the fact that so many hindrances and State interventions ran contrary to the traditional thinking of industrialists, European industry was then essentially " inwards looking." The system of small markets had to be accepted. Any plan for expansion had to rely on State orders and they were dominated by military and political considerations. In a number of European countries the currency systems were highly artificial and multiple rates were applied. Negotiators of bilateral trade agreements constantly tried to build up systems but they lasted only two months, six months, sometimes a year but rarely longer than that. No stability of outlets, outside the internal markets of the various countries, being then possible, any great ideas of expansion and future planning were extremely difficult to accept.

That situation must be borne in mind because to some people still living and exerting some influence on the policies of managements these memories are vivid and still have some bearing. Baron Snoy, however, considers the attitude of such people to be completely anachronistic when we consider the new face that Europe is assuming. It should be recalled that the small size of the European markets from 1920-39 was the reverse of the great pre-1914 tradition of European expansion, when there were no exchange or currency difficulties in the whole world. Then with small or moderate tariff walls men and goods could move freely all over the world. Those 1920-39 economic divisions of Europe had the worst influence on its political behaviour and must have been to a very great extent the cause of the second world war. Efforts were therefore made at Bretton Woods, in 1945, and at other great conferences to build up a world trade system on the ideas dominant before 1914. The circumstances were very difficult because international trade had broken down, European countries were bankrupt, nationalism was still lively and narrow minded.

After the monetary crisis of 1947 it was clear that immediate worldwide solutions were impossible : a transitional period was needed for regional organisations. It was in the undertaking and the success of this regional effort of economic reorganisation and co-operation in Europe that new ideas about the construction of a unified Europe took shape. At this point in his lecture Baron Snoy was enthusiastic in his praise of the 1947 " Marshall Plan " of American Aid to Europe. To make the best use of the dollars placed at the disposal of Europeans by the American taxpayers it was essential that the European countries should co-operate in their system of distributing that aid. This was the beginning of a rare and quite exceptional wave of common sense in European countries. The American help sufficed to create the extraordinary European reconstruction between 1948 and 1952 and when it stopped the habit of European co-operation had started. The " European Payments Union " had created a system of satisfactory and progressively complete transferability of currencies between the different European States. On the last day of the year 1958 European countries moved towards a system of free convertibility. At the same time O.E.E.C. launched an effort to liberalise international and intra-European trade with the Code of Liberation. This has been the beginning for the creation of a unified market in Europe.

Three countries had already in 1944 decided to go much further, and in the Benelux Economic Union tariff walls were entirely abolished in January, 1948. The various crises of Benelux have been valuable experience where many problems have been studied, as in a small laboratory, and the solutions found were later applicable to and adopted in the greater integration efforts.

" Little Europe " as it is known in the six countries that have formed it, was launched in 1950 by Robert Schumann with his ideas of Supra-National Authorities, the Common Market, and the Coal and Steel Community.

TABLE I

Industrial Production Indexes, based on 1953=100

Italy	182*	Luxembourg	138*
Germany	180*	Sweden	135
Greece	179	Canada	130
Austria	169	United Kingdom	130
France	166*	Belgium	126*
Netherlands	157*	Ireland	124
Norway	144	U.S.A.	119
Denmark	142		

* Common Market countries.

The adoption of the Rome Treaty by the six parliaments has greatly influenced the behaviour of the private sectors of industry in the six countries. Everybody in the industrial and commercial worlds regards

TABLE II—*Production of Aluminium, Lead, Refined Copper, Zinc, Tin and Nickel total as follows*

World production		Common Market	Free exchange Zone (U.K.).		U.S.A.	East bloc
1950	(8,938,000 tons)					
Per cent	100	14·1	7·2	(4·6)	37·4	11·3
1959	(14,209,000 tons)					
Per cent	100	14·2	6·6	(3)	29·3	20
Increase 1959/50	+ 59	+60·4	+46·2	(+46·3)	+24·2	+182
Per cent						

TABLE III—*Consumption of Aluminium, Lead, Refined Copper, Zinc, Tin and Nickel*

World consumption		Common Market	Free Exchange Zone (U.K.)		U.S.A.	East bloc
1950	(8,875,000 tons)					
Per cent	100	14·7	15·8	(12·5)	45	12·7
1959	(14,020,000 tons)					
Per cent	100	18·5	13	(9·5)	33·9	20·3
Increase 1959/60	+ 58	+98·7	+29·4	(+20)	+18·8	+151·6
Per cent						

the Common European Market as a lasting institution. This psychological position has given a growth impetus to the countries of the Common Market, which is much beyond the wildest expectations of the people who negotiated the treaty. The Baron then quoted statistics taken from O.E.E.C. Statistical Bulletins as reproduced in Table I. From these figures for 1960 the Baron concludes that there is already a substantial substructure of investment in industry in the Common Market which is such that it would be impossible to re-establish, for any reason, the divisions between the six. There is now a fundamental movement towards a unified Europe. It means that the policy of any one firm may be completely changed. Having to consider a potential market of 250 million consumers, instead of the basic national market of 60 or less millions, it must consider psychological and language differences and expect a greater number of competitors.

PROSPECTS OF THE NON-FERROUS METALS INDUSTRIES

At this point of his lecture Baron Snoy turned to consider the prospects of the non-ferrous metals industries in this new situation. Between 1950 and 1959 the annual rate of increase in the O.E.E.C. countries for industrial production has been 5·7 per cent (Steel 6·5, Aluminium 10·3, Copper 5·5, Lead 3·7, Zinc 3·7 per cent). Hence it seems that taken as a whole the non-ferrous metals industries have a rate of growth comparable to the increase of industrial production. Any large move to create an integrated Europe is bound to increase the number of possible outlets for non-ferrous metals. Only in a unified Europe can a complete aeronautical industry be possible, a successful automobile industry expand, and a scientific effort for planetary exploration be conceived. Only in a unified European market will competition be possible with the U.S.A. in a development programme for the under-developed countries. The use of aluminium will probably expand more rapidly than that of zinc or lead, but all branches of industry will be carried forward by the new wave of investments flowing out from the expectations of mankind. Marketing will become for certain managements a new and formidable challenge: this is generally a healthy development.

When in 1962 the tariffs applied between the member states will be reduced to 50 per cent of their original level, the Benelux tariff for commodities coming from Germany and France will be 0 per cent on raw aluminium and between 3 and 7 per cent on semi-finished goods. It will be between 2 and 7 per cent on copper, between 0 and 3·5 per cent on semi-finished zinc products and so on. At the same time the German tariff on raw aluminium will remain at 6 per cent, the French at 10 per cent and so on. Benelux interests may certainly consider such a transitional situation as unfair. Differences in tariff protection with third countries may aggravate the position. This is probably unavoidable and the most sensible policy is to accelerate the movement of integration. Temporary shortcomings should not be allowed to obscure the fundamental long term trends. An internal market of between 250 million and 300 million consumers with a high standard of living means a formidable outlet for the non-ferrous metal industries. An integrated European market is bound to be "outwards looking" and its strength will be used, for fundamental economic and political reasons, to help the development of the under-developed countries in Africa, Asia and Latin America.

For the next generation the possibilities and the demands for the products of the non-ferrous metals industries seem to be almost limitless. The "winds of change" are blowing in the most promising direction. In appendices to his lecture Baron Snoy quoted many figures that will be reproduced when the lecture is published in the *Journal of the Institute of Metals*. Two tables are reproduced herewith.

Thus at the end of the past decade although the U.K. and the U.S.A. were consuming more non-ferrous metals per annum they were using a smaller percentage of the total world production.

In proposing the vote of thanks to Baron Snoy, for his authoritative Autumn Lecture, which he had read in fluent English, the past-president Mr. G. L. Bailey mentioned that more than half of the journals of the Institute of Metals now go to countries overseas. The full text of the lecture would therefore be read throughout the world because it will be printed in their journal as soon as possible.

Conference on the Metallurgy of Beryllium

During the past year offers of papers were invited by the Nuclear Energy Committee of the Institute of Metals, which was then organising an international conference on the metallurgy of beryllium. (see THE ENGINEER, page 935, December 2, 1960). It appears that seventy papers have been promised and preliminary arrangements have by now been made for the international conference to take place at the Royal Commonwealth Society, Craven Street, London on October 16 to 18, 1961. The papers have been received from all parts of the world and it is clear that a great mass of hitherto unpublished work on beryllium will be discussed, after being made available to all who register for the conference.

Mechanical and physical properties of beryllium, with particular reference to deformation and fracture, elevated temperature ductility and the ductile/brittle transition are to be discussed on the first day and a half, for which some twenty-six papers are expected. Then on the afternoon of the second day there are some seventeen papers as the basis of a discussion on the use of beryllium in reactors. Here the emphasis will be on fabrication routes and testing, corrosion and compatibility and irradiation properties. Three papers then follow on the use of beryllium in aircraft and missiles. Metal preparation and fabrication are the subjects for the third day and thirty-one papers are expected. These should cover sections on pure metal preparation and fabrication, the use of beryllium-based alloys, and the application of specific fabrication techniques such as casting, powder metallurgy, rolling, extrusion, forging and joining of beryllium.

All persons registering for the conference, for which a registration fee of £12 will be charged, will receive a full set of preprints of all the papers submitted. A bound volume of the proceedings (refereed and edited papers and discussion) will be published as soon as possible after the conference.

"Corrosion Science" a New Journal

A COPY of the first issue of an international journal of the science of corrosion and protection of metals was recently received when *Corrosion Science*, Vol. 1, Number 1, August, 1961, appeared in 10in by 6¼in format. Chemical, metallurgical, and engineering journals in many countries publish, from time to time, papers on corrosion, and during the past decade many such valuable papers have been published by the Corrosion Group of the Society of Chemical Industry. There are also well-established national publications dealing primarily with corrosion, and its control or inhibition. A feeling has arisen, however, among certain of those employed more or less full time in the fields of corrosion research, that the importance and complexity of their work now justifies the existence of a journal devoted to those specialised aspects of corrosion science that can only be brought into focus by experts trained in electro-chemistry. Hence it comes that, under the auspices of the Corrosion Science Society, and of the Centre Belge de l'Etude de la Corrosion (Cebelcor), the Pergamon Press, Ltd., Headington Hill Hall, Oxford, now publish this new journal, with the aid of an international editorial board. Among the six members of this Executive Editorial Board are Dr. T. P. Hoar, of Cambridge, England; Dr. M. Pourbaix, of Brussels, Belgium; and Dr. M. J. Pryor, of New Haven, U.S.A. It is to be expected that the board will in the future accommodate corrosion scientists from still other countries in order to make it more widely international: at present the remaining three inaugural members of the board all live in England, where their work is known and their status accepted.

New Combine Harvesters

TWO new combine harvesters, the "400" and the "500," have been introduced this week by Massey-Ferguson (United Kingdom), Ltd., following more than four years' research, development and field testing in Britain, six European countries and three other continents. The smaller of the two combines, the "400," is powered by a Perkins 4-A-300D direct-injection, four-cylinder diesel engine, 4·5in bore by 4·75in stroke, with a capacity of 302·2 cubic inches. It develops 72 b.h.p. at 2000 r.p.m. and its maximum torque is 222 lb ft at 1150 r.p.m. The "500" combine differs from the basic design of the smaller model chiefly in its greater engine power and width of internal components. It is powered by a Perkins 6-A-354 direct-injection, six-cylinder diesel, 3·875in bore by 5in stroke with a capacity of 354 cubic inches. The engine develops 94 b.h.p. at 2000 r.p.m., maximum torque being 262 lb ft at 1300 r.p.m. The gear lever is on the steering column and on both models there are three forward speeds and one reverse. The hydraulics are the open-centre Cessna system incorporating a safety device rendering all the controls inoperative whenever the engine is stopped.

Fig 1—Massey-Ferguson "500" combine with 12ft table working in wheat

The reduction of operator fatigue has played a very important part in the design of the new combines. All of the main controls have been located within reach of the driver's seat, as can be seen in Fig. 2, and most of them operate hydraulically, enabling adjustments to be made to suit varying crop conditions, without the necessity for the operator to dismount. Air for the radiator is cleaned by a screen which rotates at high speed during work and is self-cleaning since chaff and large dust particles are flung off its perforated surface by centrifugal force. The air is then exhausted via a duct, and blows away from the operator's platform the dust which, under dry harvest conditions, can be a constant irritant. The working height of both machines is under 10ft, and even when seated the driver has all-round visibility, his head being higher than any part of the machine. Power steering, independent hydraulic disc brakes and a separate drum-type mechanical parking brake are standard on both models. The number of grease points on both combines has been reduced to only twenty-five, thus easing the daily maintenance routine, and the engine, as can be seen in Fig. 2, is easily accessible for servicing. Conscious of the number of accidents caused by exposed drives, and also of current and future safety regulations, the company has shielded all drives and other moving parts.

The "400" model is available with tables having widths of 8½ft, 10ft, and 12ft, whilst the "500" is equipped with either a 10ft or 12ft table. For better division of the crop, well ahead of the reel, adjustable extensions to the dividers are available. The reel is a multi-purpose pick-up type having six bats, and is raised or lowered hydraulically. It is also adjustable forwards or backwards by crank handle from the driving position. Reel speed can be varied from 14 to 50 r.p.m. by a lever on the control console. This is effected through a variable speed "V" belt pulley drive, the sliding sheaves of the controlling pulley being moved by means of a hydraulic ram.

The cutter bar, having double knife fingers with trash bars, is inclined to the ground at an angle of only 12 deg. The knife itself, which has a 3in stroke and operates at 456 cycles per minute, is driven by a mechanism consisting of a bell crank lever operated by a pitman rod driven by a single-throw crankshaft.

The auger feeding the crop into the elevator opening can be adjusted backwards or forwards as well as vertically, and auger extension flights, which provide a complete degree of overlap across the elevator opening can be added, thus ensuring that the crop is disposed evenly across the full width of the elevator. This assists high throughput by loading the threshing cylinder evenly across its entire width. The elevator from table to threshing cylinder is of chain and slatted bar construction, and the drive sprockets are mounted on a large tube at the top end to prevent wrapping of the crop. Both models incorporate a combined throw-out and slip clutch, the drives to the elevator, knife, auger and reel being stopped instantly by depression of a foot pedal on the operator's platform.

In the threshing mechanism the cylinder has eight rasp bars, whilst the concave has nine rub bars and incorporates two pre-rub plates. A steel-wire lead-out grid beneath and behind the rear beater assists in directing material on to the straw walkers, and at the same time subjects any grain held in the straw to an additional separating action. The clearance between the threshing cylinder and the concave can be adjusted by movement of a lever set against a quadrant on the driver's platform. Cylinder speed, which is considered to be one of the most important factors in obtaining a good grain sample, is subject to infinite adjustment over a selected speed range from the driving mechanism by operation of a crank handle. The variation in cylinder speed is obtained by means of variable speed "V" belt pulleys controlled through a mechanical linkage. The drive from the pulleys is transmitted to the cylinder through a reduction gearbox. The "400" combine is fitted with a single-speed gearbox permitting the cylinder to be driven at any speed between 484 and 1260 r.p.m., whilst the "500" has a two-speed gearbox allowing the cylinder to be driven at any speed between 190 and 1260 r.p.m.

The grain pans situated under the concave and the shaker shoe unit reciprocate in opposite directions, thereby giving a more efficient spread of grain on to the shaker shoe. The shoe itself is equipped with two sieves which can be adjusted to extremely fine limits. The speed of the fanning mill can be set between 488 and 766 r.p.m. and the

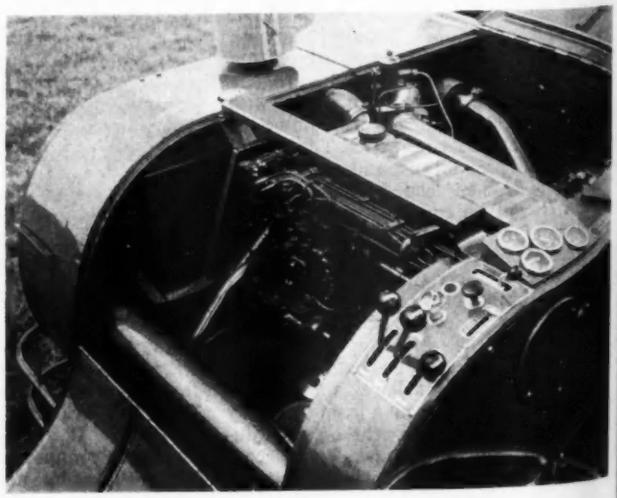


Fig 2—94 b.h.p. engine of the "500" combine

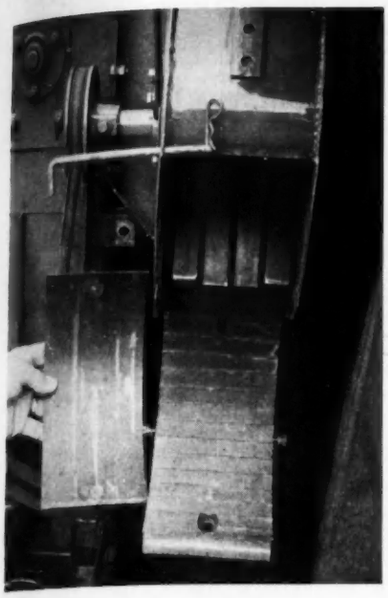


Fig. 3—Returns elevator showing paddle arms and serrated concave plate

direction of the air blast from it, which passes through the screens in the shaker shoe, can be adjusted by deflectors.

Grain separated from the straw passing over the bottomless-type, open-ended straw walkers falls on to a sloping return pan and is delivered to the pan beneath the concave. The slinger, a new device on these combines, receives the returns from a short vertical elevator connected at the bottom to a cross auger beneath the shaker shoe, and carries them round within a circular housing by means of paddle arms, and then ejects them on to the pan beneath the walkers. Returns showing signs of insufficient threshing are, in effect, rethreshed by the action of the paddle arms which subject them to impact against a serrated concave plate (Fig. 3) on the inside of the inspection door in the circular housing. Should an overload or permanent blockage occur in this part of the process an electric switch energises a warning horn behind the operator's seat.

Both combines have dual grain tanks of the saddle type. The clean grain is collected from beneath the shaker shoe by a cross auger connected to a vertical elevator, which in turn passes it to a horizontal discharge auger across the top of the tanks. The unloading mechanism consists basically of three augers. The first is horizontal and collects grain from the bottom of the tanks and passes it to a vertical auger which connects at the top with a swinging discharge auger which can be moved hydraulically to the desired unloading position.

Apart from the balancing action imparted by the " saddle " tanks even greater stability is given to these combines by the full width rear wheel track which matches that of the front tyres.

Differences between the two models include the fuel tank, which on the " 500 " holds 43 gallons as against 40 gallons on the " 400," grain tanks holding 77½ bushels compared with 65 bushels on the " 400," an output of 7 tons an hour compared with 5½ tons an hour on the smaller combine. The " 500 " has six straw walkers, whilst the " 400 " has four, its cylinder width is 45in and its total separating area 5850 square inches as against 37in and 4810 square inches on the smaller model. The height of the " 500 " is 9ft 10in, 2in more than the " 400," both are 26ft 1in in length. Wheelbase on both models is 118in and ground clearance 13½in.

Adaptable Hovercraft

WE are now able to illustrate the Vickers-Armstrongs V-A 1 hovercraft, an experimental machine designed to allow the incorporation of a variety of certain configurations. This and the other craft at present under construction by Vickers-Armstrongs (South Marston) Ltd., the V-A 2 and the V-A 3, were described briefly on page 373 *ante*. These machines are, unlike the earliest designs based on Cockerell principles, fairly fine with two fans, one fore and another aft, but are not, as is the twin-engine Denny machine (page 1096, June 30, 1961) optimised for over-water use by employing rigid side walls. Particular attention has, however, been paid to the control of spray when moving over water, and there have been developed deflectors which can be comprehended by reference to the accompanying illustrations.

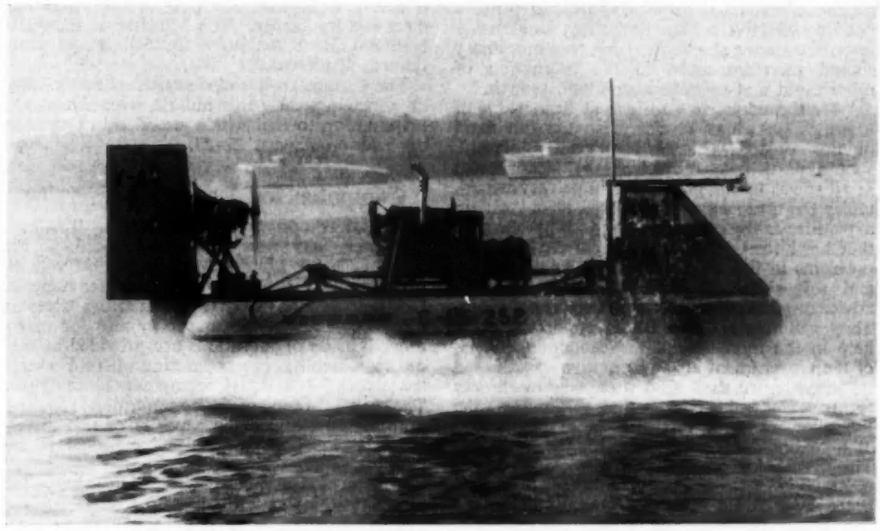
The methods of control used are also of interest. Steering when under way is by means of rudders in the slipstream and, for the single (propulsion) engined V-A 1, by vanes in the peripheral jet. (The V-A 3 will not only have controllable-pitch airscrews on both propulsion engines but also, to suppress leeway, all-moving fins near the nose.) Control of roll, and hence side force, is by spoilers throttling the internal passages to the side walls.

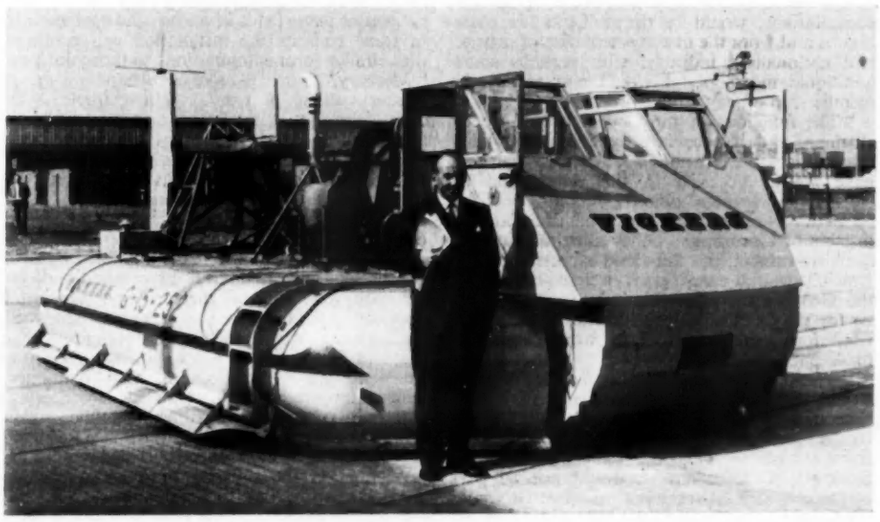
The Vickers-Armstrongs ground effect machines have all been designed to incorporate recirculation. The form taken, as seen built into, but blanked off in, various models, was that a second slot, shaped like but within and higher than the blowing slot, abstracted air from a rather deep chamber under the craft and fed it to the fan ; thus the necessity for diffusion may be much reduced.

This is an example of inward recirculation, as opposed to the outward recirculation illustrated on page 987, December 9, 1960.

These deep plenum or cushion chambers were divided by narrow vertical jet sheets which improve stability by, it may be visualised, preventing the enclosed air moving to the " high " part of the periphery. It may be interpolated that the engine mass flow is kept separate from the cushion flow, the nominal pressure rise through the fan (*c.* ½ lb per square inch) being of little value to the engine and the hot exhaust being dumped because of the fire danger that could arise from fuel being spread on the ground beneath the machine.

The illustrations also show that the V-A 1 is merely an improvised test rig. The two fans are driven by a D.H. " Gipsy Major," the inverted arrangement of which involves a long belt drive down to the fore-and-aft drive shaft. The fans are centrifugal blowers of Rotol construction resembling that illustrated on page 436 *ante* ; the tip speed is only 200ft per second. The cabin is divided into two covered cockpits to allow access for air to the forward fan. Propulsion is by a Continental flat-four with a fixed-pitch airscrew.





(Upper) The V-A 1 over water : notice that the spray keeps reasonably low. The disposition of engines and fans can be seen. (Lower)—The V-A 1 at rest : the configuration of the spray suppressors can be discerned. Notice the flywheel and broad belt pulley on the fan engine

SHORTER REPORTS

National Economic Development Council

MR. SELWYN LLOYD, Chancellor of the Exchequer, has written to the Trades Union Congress, the Federation of British Industries, the British Employers' Confederation, the Association of British Chambers of Commerce, and the National Union of Manufacturers, proposing the creation of a National Economic Development Council. In the letter, which was published last week, Mr. Lloyd said "I believe that the time has come to establish new and more effective machinery for the co-ordination of plans and forecasts for the main sectors of our economy. There is a need to study centrally the plans and prospects of our main industries, to correlate them with each other and with the Government's plans for the public sector, and to see how in aggregate they contribute to, and fit in with, the prospects for the economy as a whole, including the vital external balance of payments. The task of keeping claims on our resources within our capacity is the responsibility of Government. But experience has shown the need for a closer link between Government and Industry in order to create a climate favourable to expansion and to make possible effective action to correct weaknesses in our economic structure. This new machinery should therefore assist in the promotion of more rapid and sustained economic growth.

"I am anxious to secure that both sides of industry, on whose co-operation the fulfilment of our objectives must significantly depend, should participate fully with the Government in all stages of the process. I hope they would, under the arrangements proposed below, obtain a picture, more continuous and comprehensive than has hitherto been available, of the long-term problems in the development of our economy; and this should enhance the value of their advice on, and efforts in, the search for solutions. They would also have better opportunities to help in the moulding of the economic policies of the Government at the formative stage.

"Clearly, we shall need some new machinery for this work. I envisage that this might take the following form. First, I propose the creation of a National Economic Development Council. The Chancellor of the Exchequer would be the Chairman and one or two other Ministers, such as the President of the Board of Trade and the Minister of Labour, would be members. The other members of the Council, who would be appointed by the Chancellor after appropriate consultations, would be drawn from the trade unions and from the management side of private and nationalised industry, with perhaps some additional members. I would aim at a total membership of, say, about twenty.

"The functions of the Council would be to examine, and if necessary, commission studies relevant to the economic objectives which I have indicated earlier in this letter, and to consider how these objectives could best be secured. Responsibility for final decisions on matters of Government policy must remain with the Government, but the views expressed by the Council would carry great weight both with the Government and with industry. It would be for the Council to consider how far, and in what form, the results of its work should be made public.

"The effectiveness of the Council's work would depend on the establishment of a full-time staff of the right calibre. This staff which would work under a Director to be appointed from outside the Civil Service, although under the ægis of Government, would not be part of the ordinary Government machine. It would act under the general direction of, and be responsible to, the Council. The Government for their part would be prepared to make available from the Civil Service an appropriate portion of the staff. I would hope that the rest would be drawn from both sides of industry, the commercial world and elsewhere. Normally individual members of the staff would be re-regarded as on temporary secondment for, say, two to three years.

"The function of this staff would be to examine the plans for development of the main industries in the private sector and, in the light of such examinations and of discussions with Government Departments about other sectors of the economy, e.g. the nationalised industries, to prepare, for the consideration of the Council, studies of the kind envisaged in the second paragraph of this letter. The staff would make the fullest use of existing channels of information and consultation in Government and industry, and in the studies of particular industries would work in association with the Government Departments and other public bodies, e.g. the Iron and Steel Board and the Cotton Board, normally concerned with them.

"With the setting up of the new organisation, I would propose that the present Economic Planning Board should come to an end. My present thought is that the National Production Advisory Council on Industry might be continued but, in that event, it should in future meet less frequently. The Minister of Labour's National Joint Advisory Council would continue as at present."

The Chancellor has also suggested the holding of a meeting, early this month, with similar representation to that which attended the meeting he held on August 22–23.

Computer for London University

THE third order for a Ferranti "Atlas" computer, has now been announced. This machine is for London University and will be installed at the university's computer unit in Gordon Square, W.C.1. Computing services for all colleges of the university and for many other outside organisations are provided at this centre, which has been operating with a Ferranti "Mercury" Mark II computer since 1959. The size and range of the computations required now far outstripped the capacity of this installation. Not only is "Atlas" expected to be nearly a hundred times faster than "Mercury," but it provides much increased capacity for handling numbers and for data storage. Some details of this machine were given in our September 1, 1961, issue.

The work to be performed by "Atlas" will range over many fields of science and engineering. In some respects the installation will continue with similar form computations to those done on "Mercury," but will be able to handle a much greater volume of work. One example is in crystallography. Calculations on crystal structure already account for a major part of the computing done on "Mercury," and work has already begun on the larger molecules such as proteins and the nucleic acids. Computational methods in crystallography are still in their infancy and will be greatly developed in the future.

The "Atlas" will also make possible extensive calculations on mechanical structures; and, on the research side of meteorology, a fruitful application will be to the numerical study of mathematical models of the atmosphere. Other important applications are to studies of electromagnetic wave propagation, fluid dynamics, stellar structure, and chemical engineering. The mass of data from artificial satellites which will be arriving for analysis by the Space Research Group at University College will also require for its reduction the capacity of a large machine such as the "Atlas." Linguistic analysis and mechanical translation are rapidly growing fields of investigation at the University of London, and require a computer with a large storage capacity. Analysis of non-numerical information, using a suitably designed information processing language, is another computing problem for which, with the aid of "Atlas," it will be possible to develop and apply advanced techniques.

[Reply Card No. 1234]

Letter to Production Engineers

BELOW is a copy of a letter which Mr. Harold Burke, M.I.Mech.E., M.I.Prod.E., F.B.I.M., President of the Institution, has sent to the entire membership of the Institution.

"The present economic position of the country has been referred to as 'a crisis' or maybe, as 'another crisis,' depending upon your point of view, you may regard it as an economic crisis or a political crisis. What can we, as an Institution, do about it and what are you going to do as a member of the Institution? National productivity is the keynote of the situation. The Institution must play a leading part in directing the attention of the Government to what appear to be the weaknesses in their policy; and it must direct the attention of the members to what they can do in dealing with the daily problems of their business. We have a direct responsibility in our day-to-day application to our professional duties. We form a part of the pattern as a whole and, instead of trying to apportion the blame to other people, I believe that this is the moment for self-examination and self-determination. I have written an article for the October issue of 'The Production Engineer' which I hope you will read, but this letter is directed to you as a personal appeal to join with me in influencing the situation we have so closely to hand. Here are a few suggestions:

"(A) Economists say that a 3 per cent to 4 per cent increase in national productivity would considerably stabilise the economy. How far can you improve on this in your own administration?

"(B) Do you regularly examine cost and methods of manufacture to satisfy yourself that you are doing the best you can? However small the organisation, it is of paramount importance that a proportion of one's time should be allocated to problems of this nature.

"(C) Do you find time to keep yourself up-to-date in modern trends of your business by constant study of what other people are doing; and how far does this extend to your colleagues and subordinates?

"(D) Outside your business, do you exert all the influence you can within the Institution by,

"(i) Studying the 'Production Engineer'?

"(ii) Attending Institution meetings, joining work visits, and taking part in discussions?

"(iii) Giving full support to Local Productivity Associations?

"(iv) Giving support to Local Technical Colleges or Colleges of Advanced Technology or, where possible, the Universities; by encouraging members of your staff to attend Production Engineering courses, and by giving your service to part-time lecturing, or serving on an Advisory or Governing Body?

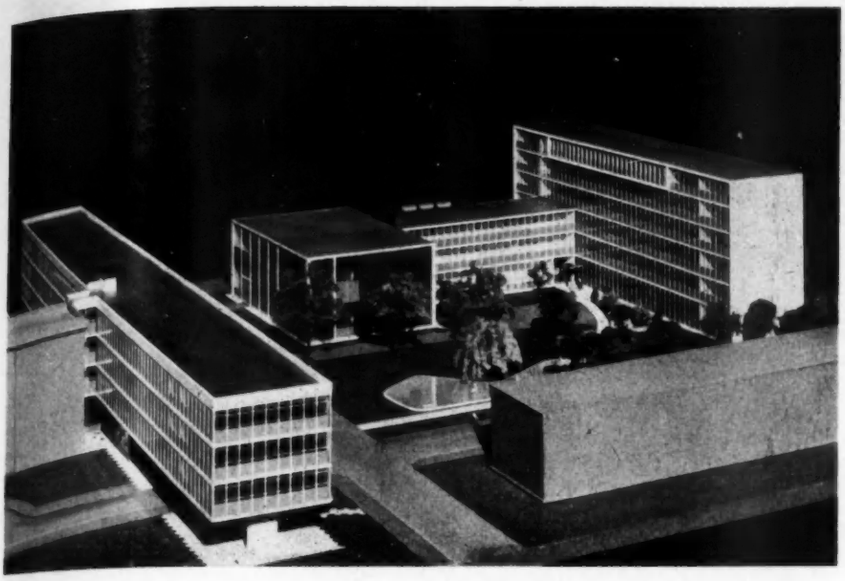
"(E) Do you help by taking part in other local organisations, such as Employers' Federations, Chamber of Commerce, &c.?

"(F) Do you use all the means within your power to spread knowledge of Production Engineering?

"(G) Are you at all time positive and active, and never negative and passive?

"It is planned that a lead will be given in the near future on national level and it is intended to pursue this theme throughout the whole of 1962.

"It will be apparent to you that within the Institution we regard the present situation as a challenge which must be met and to which we must apply what remedies lie within our power. I appeal to you therefore to make your own personal contribution towards the improvement of our National Productivity."



Model of autonomics and basic physics buildings being built at the National Physical Laboratory

New Buildings at the National Physical Laboratory

LAST Monday Mr. Richard Thompson, Parliamentary Secretary to the Ministry of Works, inaugurated the start of work on three new buildings at the National Physical Laboratory, Teddington. A photograph of a model of the three buildings is reproduced herewith. They will house, when completed, the Basic Physics Division, the Mechanical Working Laboratory of the Metallurgy Division and the new Autonomics Division. Between them these three schemes will cost about a million pounds and they represent the largest block of development at the Teddington site since the war. The Mechanical Working Laboratory should be completed by the end of next year, the Basic Physics building by February, 1963, and the Autonomics building by May, 1963.

Basic Physics

The Basic Physics building will be 320ft long and 38ft wide and have four storeys. It will span at one end a right of way into Bushey Park which passes across the site and it will be connected to the existing Applied Physics building. The work carried out in this building will involve the study of low temperatures, heat, ultrasonics, nuclear magnetic resonance, mechanical properties of materials, infra-red visible and ultra-violet spectroscopy, optical and X-ray microscopy, electrical and magnetic properties and high pressures. For these purposes it will be equipped with an unusually comprehensive set of services. A rising duct near the centre of the building will carry pressurised cold water, demineralised cold water, gas, compressed air and helium. Thence runs of piping will carry these materials in the voids above the ceilings of passageways which extend along the lengths of each floor. Electrical services will be available at 400V and 230V a.c. and 240V d.c. and 24/48/96V battery-supplied d.c. Amongst the various rooms for special purposes there will be eleven constant-temperature rooms and one variable temperature room and a dust-free laboratory air-conditioned to exclude all particles down to 1 micron in size.

The Mechanical Working Laboratory

The Mechanical Working Laboratory is being provided to enable the Metallurgy Division to work newly developed metals into bars and sheets in order that their properties and those of their alloys may be determined. The design is intended to allow for : the possibility of beginning the working with cast ingots and compacting and working metal powders ; enabling the effect of the method of working on the mechanical and physical properties of metals to be studied in the light of modern views on the nature of the solid state. Metals to be studied will include titanium and niobium.

The layout consists of a single storey main metal-working laboratory at ground level, and a three-storey wing attached, containing three smaller working laboratories, one on each floor, with associated offices, &c. The large working laboratory will have a 2ft 6in diameter circular shaft approximately 33ft below floor level to take extrusions from the press. When major redevelopment plans are put in hand in the distant future it is possible that a new road system will follow the removal of the existing ship tank. It was decided, therefore, that the new metallurgy working laboratory should be of bolted steel construction with as many prefabricated parts as possible, so that the maximum recovery value would ensue if the building should one day have to be dismantled and removed to another site.

Amongst plant to be installed there will be two rolling mills, a large vertical extrusion press and two special high-temperature/high-vacuum billet furnaces. The large rolling mill will be of roll size 15in by 20in arranged for rapid reversing. The small mill will be used for rolling strip metal from ¼in to 0·0015in for high precision in thickness and surface finish. The extrusion press will be of 700 tons capacity for hot extrusion, forging and compacting of metals.

Autonomics Building

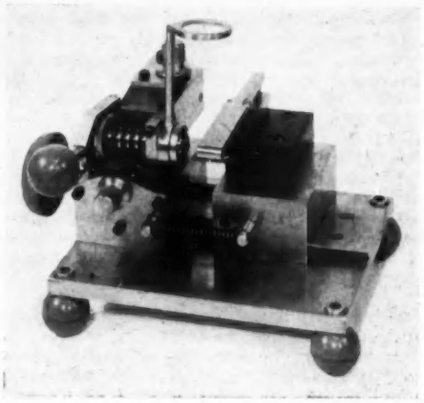
The nature of the work of the Division concerns, among other things : the development of automatic control systems, self-adapting to the nature of the controlled environment ; the recognition of printed and written characters, and the automatic translation of languages ; and the automatic indexing and retrieving of documents. In several of these fields of research it is thought the study of biological analogues will prove fruitful. The building is planned to consist of a main six-storey laboratory wing running due east and west, a three-storey connecting link for administration &c., running north and south, and a two-storey workshop situated between the Autonomics and Basic Physics blocks for the joint use of the two Divisions. There will be a silent room on the ground floor, weighing 54 tons, which will be mounted on a separate, resilient foundation. This will be virtually a concrete room inside a concrete room so that the inner chamber is completely isolated from outside noise. Next to this will be a vibration-free room for neurophysiological research on animal vision and hearing, which will be screened all round to prevent electrical interference from outside sources. A suite of dust-free rooms will also be provided, arranged to give progressive degrees of cleanliness, the final one eliminating dust particles entirely. On the ground floor will be the computer room which will have a specially designed suspended floor for easy access to the electrical services beneath it.

The new Autonomics buildings will be the first single laboratory of its kind in the world to be entirely devoted to this work. Part of the study that will go on there will be into nerve behaviour in animal systems, which it is hoped will throw light on the design of mechanical systems. The animals used for these studies will be kept on the top floor of the building, which will be fully air-conditioned.

Fine Wire Butt Welder

We illustrate a new butt welder for fine wires which has been introduced by Spembly, Ltd., of Chatham, and which is used in conjunction with the standard "Spembly" capacitor discharge power pack to enable the welding of both similar and dissimilar materials. It is stated that, with this equipment, accurate concentric alignment of wires from 0·040in diameter down to 0·006in diameter is obtainable.

The stationary component of the device carries a precision quick-releasing collet to enable one wire to be aligned in two planes by



Butt welding device for the alignment and welding of wires from 0·040in to 0·006in diameter

use of micrometer-controlled vee slides. The moving component carries a sensitive clamp for securing the second wire, which can differ in diameter from the first wire. Both components are insulated from the base and are fitted with electrode leads for connection to the power pack. Once the wires are loaded with a finite gap between them, and the correct voltage and capacity settings have been selected in the power pack, welding is carried out by rotating the controlling screw, thus bringing the two wires together and completing the discharge circuit.

Alignment of the wires is facilitated by rotating a magnifying head through two planes at 90 deg. to each other, alternatively a twin viewing head can be provided giving stereoscopic vision. The maker states that another design of unit is available for conversion into an automatic welder for certain types of production work.

[Reply Card No. 1225]

Mixed Gas Thyratrons

Two industrial thyratrons containing a mixed filling of inert gas and mercury vapour have been introduced by Associated Electrical Industries, Ltd., Electronic Apparatus Division, Lincoln. The combination is stated to achieve a short cathode heating time, and consistency of operation over a wide range of ambient temperatures as well as contributing to long life. The two valves, BT 111 and BT 113, are rated for 1500 maximum peak anode volts, and maximum cathode currents of 30A and 2A peak, 2·5A and 0·5A mean respectively. Ambient temperature range is −40 deg. to +40 deg. Cent., but for maximum life it is recommended that the valves be operated in the range +15 deg. to +40 deg. Cent. Cathode heating time is thirty seconds for the BT 111 and ten seconds for the BT 113. The latter valve can be used as a plug-in replacement for the BT 19 mercury-vapour thyratron. Standard valve bases are fitted.

[Reply Card No. 1205]

SHORTER REPORTS *(Continued)*

New Station at Barking

THE official opening of the new station at Barking, some seven-and-a-half miles from Fenchurch Street on the London, Tilbury and Southend Line of British Railways, took place on September 29. London Transport trains of the District Line also serve the station, and the new layout and buildings have been specially planned to facilitate the heavy interchange of passengers between these lines. A further service is provided by diesel trains of the London Midland Region to and from Kentish Town. All platforms are interconnected by a subway, but the the down and the up tracks of the Southend and the District lines now use opposite faces of the same platforms, so that for the majority of passengers changing trains does not involve changing platforms. The track layout alterations necessary to bring this about without conflicting movements were accomplished by building a flyover at the London end of the station and a flyunder at the other end, the latter being required to bring together again the District line tracks which are separated in the station to afford cross-platform interchange.

In rebuilding the station, provision had to be made for the overhead equipment of the London, Tilbury and Southend line electrification, now coming into operation. The deck of the concourse is of prestressed reinforced concrete beams, this construction allowing its depth to be reduced to give additional headroom for electrification equipment while maintaining the original floor level. The high-level roof above the concourse is constructed of precast concrete members, the main feature being cranked cantilever beams capped at the ends by concrete valance units. These have a span of 48ft and project 18ft beyond the front columns of the concourse, thus forming a canopy and providing cover and lighting to a new road layby on the site of the old station building. The roof (seen in the accompanying illustrations) is of precast concrete planks, covered by three layers of roofing felt and, with the main beams, is supported by concrete columns 22ft high. The wall areas between the columns are fully glazed.

At the rear of the concourse there is a low-level roof over the ticket office and passage to the platform stairways. The glass screen to the ticket office is fitted with " Melaphone " speaking windows at each of the seven booking positions. These possess individual illuminated signs which may be changed as required to cater for different traffic flows. " Rapidprinter " machines and Bollmann ticket cassettes are installed in the office for the issue of all tickets except seasons, both forms of equipment being supplied by Westinghouse Garrard Ticket Machines, Ltd. The Bollman cassette is a plastic, spring-loaded container accommodating some 130 tickets. Complete ticket dispensers are formed by assemblies of these units in steel caseworks which can be positioned horizontally or vertically.

Barking station concourse. This area is lit at night by fluorescent tubes and colour-corrected mercury lamps

Lighting in the circulating area of the concourse is by cold cathode fluorescent tubes and floodlight fittings containing colour-corrected mercury-vapour lamps. In the ticket office and ticket collecting areas the lighting is by reflector pattern fluorescent tubes housed in natural light openings so that artificial light emanates from the same region as natural light. Fluorescent fittings for general lighting were supplied by Atlas Lighting, Ltd. In the concourse and under platform awnings the cold cathode fittings were supplied by Ionlite, Ltd., while The General Electric Company, Ltd., was responsible for the cold cathode fittings on open areas of platforms.

Automatic train announcing equipment is installed at the station, consisting of a G.E.C. system operated from the signalling track circuits. Announcements are stored on magnetic tape, and after preselection by operating staff in the signal box, are broadcast as an approaching train occupies successive track circuits. When time permits two are broadcast for each train, giving notice of its approach and then identifying it at the platform. During peak hours, when the interval between trains is too short for the first announcement to be effective, this is automatically cancelled. A new signal-box, with independent sections controlling British Railways and London Transport traffic, was brought into service shortly before the official opening of the station. The British Railways section was equipped by Associated Electrical Industries-GRS, Ltd., and the London Transport section by the Westinghouse Brake and Signal Company, Ltd.

The architect was Mr. H. H. Powell, B.Arch., F.R.I.B.A., Architect, Eastern Region. Main contractors were Charles R. Price for the station; W. and C. French, Ltd. for the signal-box and station subway; Herbert Richardson and Sons Ltd. for technical departments' accommodation; and Holmpress Piles, Ltd. for piling.

Frontage of the new British Railways station at Barking

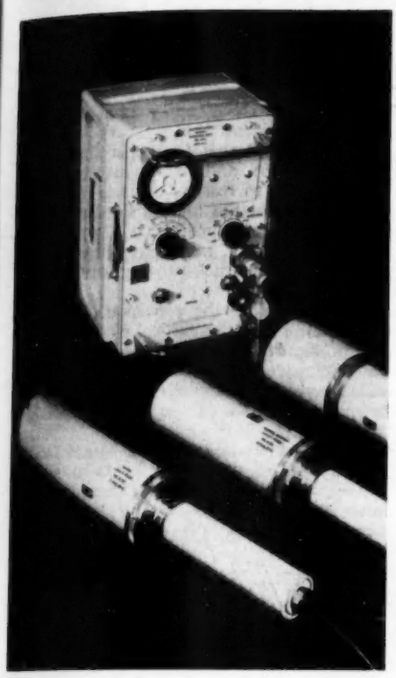
Advisory Council on Scientific Policy

LORD HAILSHAM, Lord President of the Council and Minister for Science, has appointed two new members to the Advisory Council on Scientific Policy for the period ending July 31, 1964: Sir Willis Jackson, F.R.S. and Sir Alan Wilson, F.R.S.

Sir Willis Jackson, at present Director of Research and Education, Associated Electrical Industries (Manchester), Ltd., became Professor of Electrical Engineering at the Imperial College of Science and Technology in South Kensington on October 1, 1961. He is a member of the University Grants Committee and has served on a number of Government Councils and Committees, including the Research Council of D.S.I.R., the National Council for Technological Awards, the Committee on Supply and Training of Technical Teachers and the Committee on the Management of Research. Sir Alan Wilson is Deputy Chairman and Managing Director in charge of Research and Development, Courtaulds, Ltd. He has served as Chairman on the Committee on Coal Derivatives and is at present Chairman of the Committee on the Problem of Noise.

Portable Neutron-Gamma Monitor

A NEW portable neutron/gamma monitor (Mark 2NRM), in which measurements are made by scintillation counters, has been introduced by Plessey Nucleonics, Ltd., Weedon Road, Northampton. Separate detector probes, equipped with appropriate phosphors are available for detecting fast neutron, thermal neutron and gamma radiation. Indication is on a meter directly calibrated in milli-rem per hour ; in addition, at very low neutron dose rates, dose integration can be measured. The monitor has been designed to Admiralty specifications for measurement of the biological dose from neutron and gamma radiation in the vicinity of a propulsion reactor.



Portable neutron-gamma monitor. Measurement is by scintillation counters housed in the cylindrical probes shown here in front of the indicating unit

For thermal neutrons the following ranges are available : 0 to 0·03, 0 to 0·1, 0 to 0·3, 0 to 1, 0 to 3, 0 to 30 mrem per hour where 1mrem per hour=250 n/cm² per second. Measurements may be made in the presence of gamma radiation of 100 times the equivalent dose rate (up to a maximum of 300 mrem per hour). For fast neutrons the ranges are : 0 to 1, 0 to 3, 0 to 30, 0 to 300 mrem per hour where 1 mrem per hour=4 n/cm² per second. Measurement may be made on the two most sensitive ranges in the presence of gamma radiation of 100 times the equivalent dose rate. The effect of higher dose rates is dependent on energy ; at 6 MeV gamma breakthrough begins at a few hundred mrem per hour. Response is within ±20 per cent over the fast neutron range 2 to 10 MeV.

For gamma radiation the ranges are : 0 to 0·3, 0 to 1, 0 to 3, 0 to 30, 0 to 300 mrem per hour. The gamma radiation which the equipment will be required to measure in the application for which it has been designed is predominantly in the 4 to 5 MeV region, but the range 0·1 to 6 MeV is covered.

The indicator unit contains the battery pack and electronic circuits. Except for one electrometer pentode, all circuits use transistors. Indication is on a 3½in scale length moving-coil meter. In addition to the direct calibration in dose rate there is a red mark to indicate 100 counts on an " intergrate " range, so that very low counting rates can be measured within a statistical accuracy of 10 per cent.

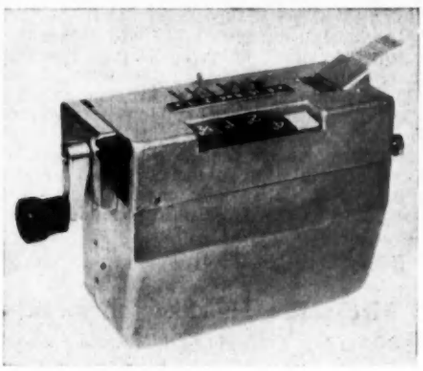
The equipment is designed to meet general British inter-service requirements, and to withstand climatic and durability testing to specification K114G. The indicator unit and the three types of scintillation probe are all sealed and desiccated. The indicator unit measures 12in by 8in by 7in and weighs 11 lb. As shown in the illustration the probes are of cylindrical construction with approximate overall dimensions (varying slightly for the different applications) of diameter 3in, length 11in ; weights range from 3½ lb to 5 lb. The probes are fitted with 1¾in diameter handles. Alternative handles are available with glanded cable entries suitable for underwater operation and the probes may be operated up to 50ft from the indicator unit. The power pack contains sixteen Mallory RM 12R cells, series connected in a single battery with a 50-hour life. Battery condition can be checked on the indicator meter.

The equipment is capable of withstanding temperatures in the range 0 to 55 deg. Cent., but accuracy is affected if probe temperature exceeds 40 deg. Cent.

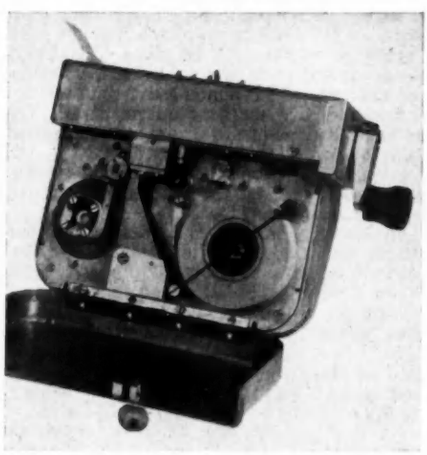
[Reply Card No. 1221]

Ticket Issuing Machine

IN collaboration with public transport undertakings, a ticket issuing machine for bus conductors has been developed by Creed and Co., Ltd., Telegraph House, Croydon, Surrey, which simultaneously code-punches details of transactions in paper tape. This tape is subsequently fed into an analyser which automatically produces a sterling total of the day's takings together with statistical information. The machine, constructed of light alloy, weighs 6 lb and measures 8¼in by 4in by 6½in. It comprises separate ticket roll and tape-punch compartments, the latter, shown open in one of the accompanying illustrations, being provided with a Yale lock and key as a safeguard against unauthorised access.



Ticket-issuing machine with automatic recording of transactions on paper tape



Rear compartment with ticket punching mechanism and tape take-up reel

Preprinted tickets are issued from a single roll of 2500 tickets, each measuring approximately 1½in square. Each ticket bears five fare values and combinations of these are punched out so that the sum of the remaining figures represents the fare paid. Punching is controlled by five fare value keys mounted on the top of the machine, arranged to make possible a range of thirty-one fare values between ½d. and 1s. 3½d. When a ticket of a higher value is required a double or " married " ticket is issued. Fare stages are recorded on the ticket by another set of punches controlled by five preset levers mounted behind the fare value keys. A sixth lever sets an additional punch which is used to denote the class of ticket issued.

When the settings are made, the ticket is issued by a single revolution of the operating handle. This action punches the ticket, partially cuts it to facilitate tearing off, and ejects it through a slot in the top of the machine. The fare keys are automatically reset after each issue, but multiple issues of a single value can be made by operating a small button on the side of the machine. In the event of a conductor making an incorrect setting on the fare keys, they may be reset by pressing the same button.

The recording tape is ⅜in wide and is stored within the machine in a roll lasting an average of ten to fourteen days. At the end of the conductor's duty the tape is taken out of the machine and fed into the automatic analyser in the accounting department. Comprising a tape reading device coupled to an electro-mechanical arithmetic unit, the analyser is completely automatic apart from a few simple dial settings which must be made when the unit is being used to compile statistics. As the tape passes through the reading head a series of counters progressively indicates the sterling total, the total number of passengers carried and the individual totals of each value of ticket issued.

[Reply Card No. 1222]

Iodine-Treated Lamps

MINIATURE lamps with an iodine-treated argon gas filling are now in commercial production by The General Electric Company, Ltd., " Osram " Lamp Division, East Lane, Wembley, Middlesex. The inclusion of iodine, to which we referred in our January 20, 1961, issue, page 70, enables high-power filament lamps to be made in very small sizes which previously would have been impracticable because of blackening of the glass. The first iodine lamp to become available will be a 200W, 6·6A pattern which has already been in service for demonstration purposes in visual landing aids at Luton Airport. For convenience of installation in existing fittings, where high accuracy of optical alignment was necessary, these lamps, complete with their miniature bulbs, were enclosed within a conventional bulb and cap. As supplied normally they are approximately 2in long and ½in in diameter. Later, a tubular floodlighting lamp will become available in 500W, 1000W and 1500W sizes. The 1500W lamp will be only 9in long and ⅜in in diameter as compared with the 14in length and 6½in diameter of the standard equivalent. A third form of iodine lamp still under development is a 100W projector lamp for 8mm cine-projectors, which will be no larger than Christmas tree decoration lamps. All these lamps are stated to give 15 per cent more light than their standard equivalents.

[Reply Card No. 1189]

Sealed Spiral Conduit

AN improvement in the metal-to-metal lock-joint of spiral conduit has been introduced by Metal Sections, Ltd., Oldbury, by the incorporation of a rubber mastic sealing compound into the lock-joint as it is being formed. It is claimed that the sealing compound provides an airtight tube ; maintains the lock-joint when subjected to rough treatment during transit and on site ; and allows for expansion and contraction of the joint as a result of temperature variations within an air-conditioning system.

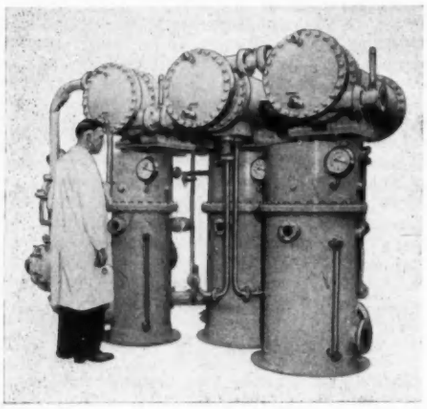
The maker states that leakage tests have been successfully carried out on the new tube up to a static internal pressure of 15 lb per square inch. The improved joint is now being incorporated in all " Metsec Helitube " conduit which is available from 3½in up to 24in diameter, and in three different gauges ; 25 swg (·020in), 22 swg (·028in) and 20 swg (·036in) in any suitable ductile metal.

[Reply Card No. 1223]

SHORTER REPORTS *(Continued)*

Developments in Water Distillation Plant

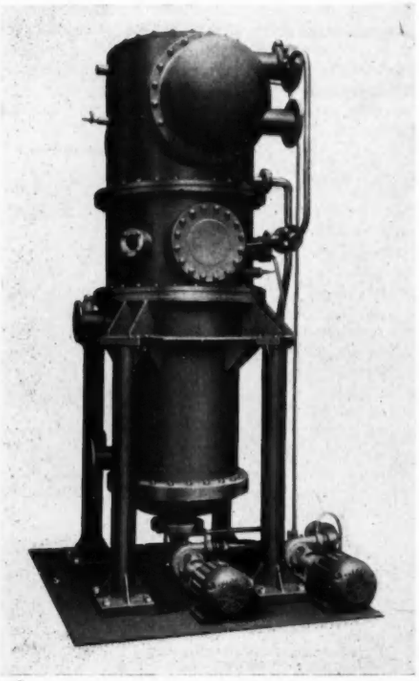
THREE additions have been made to the range of water distillation plant designed and built by Buckley and Taylor, Ltd., Castle Iron Works, Oldham, a member of the Brightside Group. They comprise a diesel-electric flash distillation plant, and two variants of the company's "Aquaflash" equipment, one designed for simple installation in existing ships and the other for using the waste heat from diesel engines. The introduction of the new equipment marks the



"Aquaflash" generator designed for breaking down into small units for ease of installation

centenary year of the company, which was founded in 1861 to make steam engines and power transmission equipment, principally for the textile industry.

The diesel-electric plant is entirely self-contained, being mounted on skids, and has a rated output of 10 tons of fresh-water per day from sea or brackish water. Known as type AF3 the plant can be operated by its own diesel alternator, which is separately skid-mounted, and



"Aquagenerator" for use with waste heat at any temperature above 120 deg. Fah.

supplies all the current necessary for an immersion heater and the pumps. Alternatively, if there is an electric supply available on the site, the diesel generator can be dispensed with and the plant connected to the mains.

For installation in existing ships, where access is limited, the AF2 flash generator has been designed. This is available in a standard range of capacities from 25 to 50 tons of distillate daily; other sizes are made to order. The AF2 incorporates all the features of the company's standard equipment, but is broken down into small sections of relatively light weight. Each flash chamber is supplied as a separate fabrication of simple circular shape. Each vapour condenser is likewise separate, ready for assembly on top of its associated flash chamber. With this design a wide range of installation arrangements is possible. For example, where there are two possible locations for a distillation plant but neither is large enough to house it all, the AF2 can be split into sections and connected by a simple piping layout; it can, in fact, be distributed round a ship's engine-room to make use of any otherwise waste space. Almost any source of heat can be used in the AF2; steam, hot water or waste gases are the usual means of heating.

The third of the new distillation plants is the "Aquagenerator," which is designed specially to use waste heat at any temperature above 120 deg. Fah. It is available in five standard sizes with outputs from 4 tons to 30 tons per day, and in other capacities to special order. This plant is particularly suitable for use with diesel engine jacket cooling water in the range 145 deg. to 170 deg. Fah., but any other source of low grade heat down to 120 deg. Fah. can be used satisfactorily.

[Reply Card No. 1244]

Mechanical Handling of Road Vehicle Loads

THE Report has now been published of the Joint Study Group (drawn from the Institute of Materials Handling, the Institution of Production Engineers, and the Institute of Road Transport Engineers) for Road Transport Materials Handling set up by the National Joint Committee on Materials Handling. The Study Group limited itself to considering the loading and discharge of "common-user" road vehicles and in particular the flat-platform truck. The recommendations of the Group are summarised below:

(*a*) The construction of commercial vehicle platforms to facilitate the handling of materials by mechanical means:

(1) That the number and spacing of cross-bearers and the strength of the floors in flat-platform vehicles be such as to render those floors susceptible to withstand a 1-ton load carried on a hand or powered pallet truck. This would involve a maximum loading of 1650 lb per wheel, giving rise to a potential load of (1650 by 2) lb between any two cross-bearers, and with any one plank laid longitudinally accepting a wheel loading of 1650 lb.

(2) That the surface hardness of vehicle platform floors be such as to reduce rolling resistance to the minimum whilst affording a high degree of durability and non-slip potentiality, having regard to the safety of persons walking on these floors.

(3) That, in connection with the majority of normal-user vehicles, 48in is regarded as being a satisfactory standard loading height.*

(4) That wherever practicable 86in shall be the minimum width between raves, to accommodate pallet sizes.

(5) That the maximum height of side raves on flat platform vehicles be 1½in.

(6) That the bracing of head (loading) boards be such as not to interfere with the handling of the foremost pallets over the side of an open vehicle.

(7) That the design of vehicle bodies be such that drop sides will hinge away flush to the periphery of the vehicle, wherever chassis design renders this practicable.

(*b*) Other recommendations:

(1) In the case of box vans, rear openings should be of maximum width, and the width of side pillars should be kept to the minimum, to facilitate mechanical loading techniques.

(2) Recommendations 1, 2 and 3 under paragraph (*a*) above apply equally to closed vehicles such as box vans.

It is envisaged that the pallet size used will be 40in by 40in, and that it may be desirable for the pallets to rest on the side raves of the platform so that the load is tilted towards the centre line of the vehicle. When loading a truck from the end, raves give some protection against the pallet truck running over the side of the platform.

It is feared that the provision of drop sides which hang inside the vertical plane through the edge of the deck, allowing the vehicle to stand close alongside a dock, can only be effected on a vehicle initially designed with this object in view, the position of the wheel arches being critical.

The recommendations made should facilitate the carriage of the three kinds of universal container developed by the International Container Bureau.

[Reply Card No. 1242]

* Measured with the vehicle unladen—Ed., THE E.

Fork Truck Stability Tests

THE British Industrial Truck Association, of 94–98, Petty France, London, S.W.1, has adopted and published a series of acceptance tests for fork lift trucks in respect of stability. The tests were proposed by the Industrial Truck Association of the United States of America, and have been adopted by manufacturers' associations in the member countries of the Fédération Européenne de la Manutention. The tests are performed on a tilting platform, and require that the loaded vehicle shall not overturn when the platform is inclined as follows:

Forks down and fully rearward: 10 deg. 12 min. (18 per cent) forwards.

Forks at highest position (trucks with masts fixed in pitch only): 42 deg. 18 min. (4 per cent) forward up to 10,000 lb load; 2 deg. (3·5 per cent) forward over 10,000 lb and up to 20,000 lb load.

Forks fully raised and tilted back: 3 deg. 27 min. (6 per cent) about axis joining lower load-carrying wheel to median point of steering wheels.

Forks raised 12in and tilted back: angle giving gradient at right angles to axis joining lower load-carrying wheel to median point of steering wheels of $15+1{\cdot}75V$ per cent, where V is the maximum speed of the truck.

It should perhaps be emphasised that although the tests are carried out with an idealised load simulating a homogeneous 4ft cube, V is measured with the vehicle unladen.

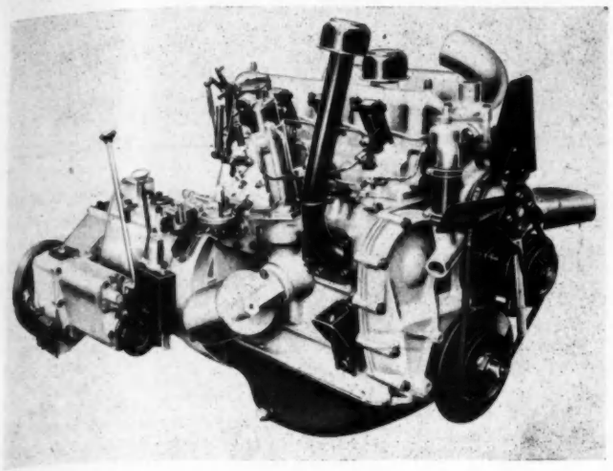
Copies of the booklet describing the tests are available from the Association, price 2s. 6d.

[Reply Card No. 1243]

Secure Switches

THERE has been announced by Joseph Lucas, Ltd., a lockable electric switch, the S45 "Anti-Theft Master Switch," intended to secure unattended road vehicles against tampering. The new switch, in contrast to many door and ignition locks, bears no number identifying the shape of the key, although the key itself is so numbered. To protect a vehicle against violation, such a switch can be placed on the outside and wired in series with the horn and with a number of switches, in parallel, which detect opening of the doors. To prevent the vehicle being driven away, the master switch can be arranged to connect the horn to the ignition system.

[Reply Card No. 1216]



The new "Land-Rover" 2¼-litre diesel engine

Improved Diesel Engine

An oil engine capable of direct substitution for the then existing petrol engine in the "Land-Rover," was introduced by the Rover Company, Ltd., Solihull, Warwicks in 1957, (The Engineer, June 14, 1957). The engine, nominally 2 litres, was 2052 c.c., and had a gross power of 52 b.h.p. at 3500 r.p.m. This unit has now been superseded by a 2¼-litre, 2286 c.c. diesel engine, basically similar in layout and design but with an appreciable increase in all-round performance by virtue of a 21 per cent increase in brake horsepower and greatly improved torque range. The brake horsepower has gone up from 51·2 b.h.p. at 3500 r.p.m. in the 2-litre engine to 62 b.h.p. at 4000 r.p.m., and the torque has increased from 87 lb ft at 2000 r.p.m. to 103 lb ft at 1800 r.p.m. The speed range for the Regular Diesel "Land-Rover" has been increased to a governed top speed of 60 m.p.h. as opposed to the previous 52½ m.p.h. On the long-chassis models, the Long Diesel "Land-Rover," the governed maximum speed is 66 m.p.h. due to the larger diameter tyres fitted. The engine has four cylinders, 3 $\frac{7}{16}$ in bore by 3½in stroke, overhead inlet and exhaust valves, and a compression ratio of 23 : 1.

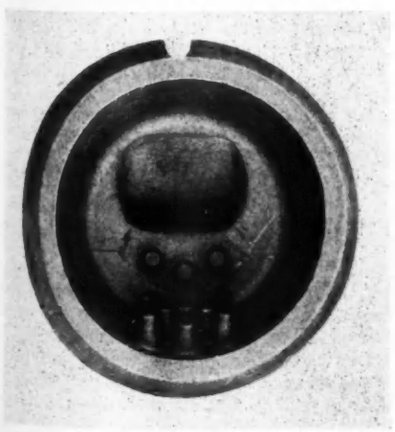
Of particular interest is the Rover provisional patent incorporated in the Ricardo "Comet V" combustion chamber. This was developed in the 2-litre engine and appears in a new form in the 2¼-litre engine. As can be seen from the illustration we reproduce, it takes the form of pimples, which, it is claimed, improve the heat transfer between the chamber surface and the gas, and assist the mixing of air and fuel, giving an ultimate reduction in noise by reducing the delay period and thus permitting a more retarded timing without loss of efficiency. It also makes for easier starting at very low temperatures. Tests have shown that quick starting can be obtained at temperatures as low as −20 deg. to −30 deg. Cent.

Integral cylinder bores are used as these have been found to have increased life over the wet liners in the 2-litre engine. Pistons have a "V"-trough in the crown. A new crankshaft of increased strength, by virtue of bigger diameter crankpins and increased fillet radii, has been introduced. Journals are unchanged.

A speed sensitive automatic injection advance is now fitted to the C.A.V. distributor pump covering a range of 5 deg. crankshaft operation, which allows the engine to run satisfactorily up to 4000 r.p.m. full load.

The increase in the cubic capacity of the engine has led to a number of other technical improvements being made. The cooling capacity has been increased with a larger radiator and larger fan. A heavier flywheel has been fitted giving an 8 per cent increase in inertia. The sump has been constructed with a stiffer flange, and a new rear oil seal has been fitted to the engine. The design of the inlet manifold has been improved by a larger bore air cleaner, to give increased torque at low engine speeds. The camshaft is made of case-hardened steel and cams have been designed to give a high valve lift while ensuring the minimum stress on the valve operating gear. An interesting feature of the Rover diesel engine is the design of the roller-type tappets. The roller which follows the cam runs in a lead-tin plated bronze shoe which in turn slides in a nickel chrome cast iron tappet guide. In this way the high valve lifts and consequent high acceleration needed for good engine breathing are obtained with a minimum of wear on the cams.

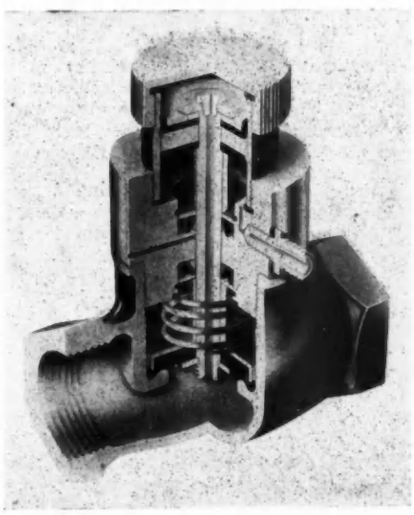
[Reply Card No. 1241]



The Ricardo "Comet V" combustion chamber showing the pimples which improve the heat transfer and assist the mixing of air and fuel

Remote Control Globe Valve

A globe valve to control the flow of liquids or gases in systems with pressures up to 125 lb per square inch, and arranged for operation by pneumatic or hydraulic remote control is now made by Perrett Control Company, Ltd., Green Lane, Hounslow, Middlesex. This new valve is made in non-ferrous metals throughout with synthetic rubber valve seats, piston cups and gland seals. This valve is available in sizes ranging from ¼in to 3in with British (B.S.P.) or American (N.P.T.) threads and flanges.



Globe valve arranged for remote hydraulic or pneumatic control and for working pressures up to 125 lb per square inch

As can be seen in the sectional photograph we reproduce the design is such that the line pressure ensures a tight shut off. When the valve is closed the liquid or gas entering the inlet passes through the hollow spindle and fills the cylinder at the top of the body. A piston in this cylinder has a greater surface area than the valve disc and keeps the seat firmly in the closed position despite variations in line pressure. The application of the control pressure to the underside of the piston overcomes the downward thrust and causes the valve to open. The rate of valve opening is controlled by the size of an interchangeable nozzle fitted in the bore of the spindle and the control pressure necessary to open the valve is considerably lower than the working line pressure.

When the control pressure is released the line pressure acting on the top of the piston, aided by a phosphor bronze return spring, closes the valve. The rate of closing is determined by the size of the nozzle which controls the charging of the upper cylinder and produces non-concussive closing.

[Reply Card No. 1226]

Safety Hats

To increase the comfort and ease of wearing its safety head gear, Safety Products, Ltd., Holmethorpe Avenue, Redhill, Surrey, has introduced a new form of head harness for protective hats. This new head harness consists of a moulded polythene spider cradle which fits over the head. The end of each leg of the cradle has an adjustable device consisting of a nylon stud which can be moved up and down in a slot in the part of the leg that is attached to the hat itself. With this form of fitting instead of making a general adjustment by draw string the individual legs can be adjusted to allow for the varying contours and shapes of heads. Adjustment for circumference of the head is carried out by two nylon studs fitting into two parallel lines of holes on each side of the band and it also enables the hat to be worn in a headsling style if desired, thus eliminating the necessity for a chin strap, except in unusual or gale conditions.

A soft foam plastic plate is incorporated inside the top of the cradle and there is a safety head clearance of more than an inch. A replaceable buffer band fitted is quite separate from the harness and provides protection at the back of the hat when it is worn headsling style. The sweatband, which consists of a self-adhesive soft plastic foam strip, is easily renewed and the polythene head harness may be readily cleaned and sterilised for re-issue. There are no metal parts either in the hat or harness thus providing a safety headgear suitable for use in the electrical as well as other fields.

[Reply Card No. 1227]

Launches and Trial Trips

Linkmoor, cargo ship; built by Hawthorn Leslie (Shipbuilders), Ltd., for the Moor Line, Ltd.; length between perpendiculars 435ft, breadth moulded 60ft 6in, depth moulded to upper deck 38ft 9in, draught 27ft 1¼in open shelter, 29ft 4in closed shelter; corresponding deadweights 10,360 tons and 11,730 tons, service speed 15 knots; four holds and deep tank, one 30-ton and 10-ton and 5-ton derricks; three 200kW diesel-driven generators; Hawthorn-Doxford, five cylinder opposed piston oil engine, 5500 b.h.p. at 115 r.p.m. Trial, July 27.

Lagos Palm, open shelter deck cargo liner; built at its Neptune works by Swan, Hunter and Wigham Richardson, Ltd., for the Palm Lines, Ltd.; length between perpendiculars 440ft, breadth moulded 63ft, depth moulded to shelter deck 37ft, deadweight 8500 tons on 25ft draught; five cargo holds, one 50-ton, four 15-ton, two 10-ton and ten 5-ton derricks, three bipod masts, three 250kW diesel-driven generators; Swan, Hunter-Doxford oil engine, six cylinders, 700mm bore by 2320mm combined stroke, 7500 b.h.p. at 118 r.p.m., arranged to burn boiler oil; trial speed 17¼ knots. Trial, July 25.

INDUSTRIAL NEWS

United Kingdom and World Exports

According to a survey of trends in United Kingdom and world exports contained in the current issue of the *Board of Trade Journal*, exports by the twelve main manufacturing countries, apart from the U.S.S.R., Eastern Europe and China (mainland), increased by 15 per cent in value between 1959 and 1960, the largest increase in any post-war year. Most of this increase was due to a rise in volume of about 13 per cent. This was much greater than the increase in world industrial production, the survey points out, and was in part associated with a move to replenish stocks and with a high rate of fixed investment in Western Europe. Nevertheless, over the longer period since 1954, the survey adds, exports of manufactures have increased more than industrial production—exports have increased by 60 per cent in volume and production by less than 40 per cent.

United Kingdom exports of manufactures were 7 per cent more in value in 1960 than in 1959, about half the rate of increase achieved by manufacturing countries as a whole. This relationship between the expansion of United Kingdom exports and world exports of manufactures holds also over the period from 1954 to 1960. Although, generally, the United Kingdom's exports have increased at about half the rate achieved by manufacturing countries as a whole, the survey says, this relationship does not hold true for every main market. The countries which succeeded in expanding their exports at the fastest rate between 1954 and 1960 were Italy, Japan and Western Germany, in that order. The United States increase was 51 per cent compared with 38 per cent for the United Kingdom and a world average of 75 per cent. In terms of absolute values, however, only Western Germany and the United States achieved a larger increase than the United Kingdom.

Engineering Wage Claim

A claim for an increase in the rates of wages of all adult male workers in the engineering industry, an increase for the women workers which would give the adult women the same minimum rate as the adult male labourer, and a reduction of hours of from forty-two to forty a week, was presented to the engineering employers last week by the Confederation of Shipbuilding and Engineering Unions. The case for the unions was presented by Mr. W. J. Carron, chairman of the Confederation's engineering committee and President of the Amalgamated Engineering Union.

The general grounds for the wage claim were, Mr. Carron said, that there had been a significant rise in the cost of living during the past year and that it would inevitably rise still further during the next few months as a result of the recent measures taken by the Chancellor of the Exchequer. Present rates of wages were too low to provide a reasonable standard of life at to-day's prices and also did not adequately reflect the value of the work which was performed by the workers. In view of the increasing productivity of labour in the industry in post-war years, he added, and the high and increasing level of profits and dividends, the workers had a right to a wage increase and the industry could well afford to give them an increase.

It was deplorable, Mr. Carron continued, that the rate for a skilled craftsman, who had served a five years' apprenticeship, was still well below £10 per week, while the average weekly earnings of all workers, skilled, semi-skilled and unskilled, in all manufacturing industry in the country was approaching £16 per week.

With regard to the women's claim, Mr. Carron said, the grounds were, as had been the case for many years, that the present rates being paid to them were scandalously low and bore no relation to the value of the work they performed in industry.

In his statement on the claim for a forty-hour week, Mr. Carron said that when hours were reduced from forty-four to forty-two a year and a half ago, it was made clear that the unions accepted that settlement as a further stage towards the goal of a forty-hour week which they had been pursuing for more years than he cared to remember.

The main reason for demanding a forty-hour week at this time, Mr. Carron stated, was the belief that a rapid development of automated techniques of production might threaten the industry with employment difficulties. The unions were fully behind any management which brought its production plant right up-to-date by that means, even though they realised it often involved a saving in labour. But the stipulation was made, he added, that, by and large, time saved must be shared among all employees by a reduced work-week and not operated at the expense of a minority who would become redundant. The problem seemed to have taken on a new urgency in view of Britain's likely membership of the European Common Market. This was almost certain to cause British firms to invest at a higher rate than previously in labour-saving equipment, producing more with less man-hours.

Industrial Disputes

The Ministry of Labour's most recent statistics show that the number of stoppages of work due to industrial disputes in the United Kingdom beginning in August was 192. In addition twenty-three stoppages which began before August were still in progress at the beginning of the month. The approximate number of workers involved during August at the establishments where these 215 stoppages occurred has been estimated at 39,300; this includes 7100 workers involved in stoppages which had continued from July. Of the 32,200 workers involved in stoppages which began in August, 30,600 were directly involved, the Ministry says, and 1600 indirectly involved. The aggregate of 122,000 working days lost during the month included 52,000 days lost through stoppages which had continued from July.

In the coal-mining industry there were 116 stoppages in progress during August, involving 14,700 workers and a loss of 27,000 working days; in the metal manufacturing group, eleven stoppages involved 3300 workers and a loss of 26,000 working days; in engineering there were sixteen stoppages involving 5800 workers and a loss of 17,000 working days; in the shipbuilding and ship-repairing industry, three stoppages involved 1400 workers and 14,000 working days were lost; in the construction industries there were twenty-five stoppages which involved 3600 workers and accounted for 15,000 working days being lost, and in the remaining industries and services covered by the statistics there were forty-four stoppages involving 10,500 workers and these resulted in a loss of 24,000 working days.

Payment by Results

An inquiry into the earnings and hours of manual wage-earners in manufacturing industries generally and in some of the principal non-manufacturing industries and services was undertaken by the Ministry of Labour in April, 1961 (THE ENGINEER, September 15, 1961). The total number of establishments covered by the inquiry was approximately 58,100, and about 55,300, or over 95 per cent, of them gave separate figures showing the number of wage-earners paid only at time rates or receiving a standing wage, and the number paid wholly or partly under any system of payment by results. The results show that between October, 1957, and April, 1961, there was an increase from 31 to 33 per cent in the proportions of wage-earners paid wholly or partly under systems of payment by results in all the industries covered, taken as a whole.

At just under 33 per cent of these 55,300 establishments, the Ministry says, some of the workers were paid under systems of payment by results, whilst for manufacturing industries alone, the percentage of establishments was 47. The total number of workers paid under such systems, in all the industries covered, was over 2,250,000, or nearly 35 per cent of the total number of wage-earners at work in the third pay-week in April, 1961, in the 55,300 establishments.

In the engineering and electrical goods industries covered by the survey it was found that 54 per cent of the men were timeworkers, whilst 46 per cent were workers on payment-by-results systems; in shipbuilding and marine engineering, 33 per cent were timeworkers and 67 per cent were workers on payment-by-results systems, and in the motor vehicle industry 48 per cent were timeworkers whilst 52 per cent were workers on payment-by-results systems.

Unemployment

The Ministry of Labour reports that on September 11, 1961, there were 317,033 people registered as unemployed in Great Britain, of whom 134,161 had been unemployed for more than eight weeks. The total includes 39,179 married women and 14,565 school leavers. During the period August 14 to September 11 unemployment rose in most industries and services. The increase of 21,000 in manufacturing industries was mainly among the temporarily stopped, the Ministry says, and included 9400 in the vehicle industry, 6300 in the textile industry and 2900 in metal manufacturing. There was a reduction of 17,600 in the number of school leavers registered as unemployed.

Between August 10 and September 6 there were decreases in the number of unfilled vacancies in all industries and services. A reduction of 14,000 in the manufacturing industries included decreases of 3600 in the engineering and electrical goods group and 2000 in the textile industry.

PERSONAL AND BUSINESS

Appointments

MR. HAROLD LIONEL LOMAX, has been appointed assistant export manager of The Villiers Engineering Company, Ltd.

MR. H. KAY, M.I.Mech.E., has been appointed assistant managing director of the engineering division of Tube Investments, Ltd.

MR. H. SMITH, chairman and joint managing director of British Ropes, Ltd., has joined the board of The United Steel Companies, Ltd.

MR. FRANCIS JONES has been appointed managing director of Robert Harris, Ltd., the metal pressings division of the Villiers Group of Companies.

MR. R. B. W. BOLLAND, formerly general manager of Head Wrightson Stockton, Ltd., has been appointed London manager of Head Wrightson and Co., Ltd.

MR. DONALD MITCHELL has been appointed secretary of The Butler Machine Tool Company, Ltd., in succession to Mr. Harold S. Mitchell, who is retiring at the end of November, 1961.

THE GRIFFIN AND GEORGE GROUP OF COMPANIES, announces the appointment of Dr. Dennis S. Beard to the board of Griffin and George (Sales), Ltd., in the capacity of technical sales director.

MR. E. L. TUFF, M.I.Prod.E., director and general manager of the Projectile and Engineering Company, Ltd., Thessaly Road, London, S.W.8, became deputy managing director on October 1.

MR. SIDNEY H. IRELAND has been appointed managing director of Consolidated Pneumatic Tool Company, Ltd., in succession to Mr. Norman Readman, who becomes chairman of the board.

DR. W. J. BATES has joined R. and J. Beck, Ltd. as chief engineer. Pending completion of the company's new factory at Watford, he will be located at Lister Works, Dickenson Street, London, N.W.5.

THE MINISTRY OF AVIATION announces the reappointment of Sir Basil Smallpeice, as a member of the board of the British Overseas Airways Corporation for a further period of five years to September 30, 1966.

DRUMMOND-ASQUITH, Ltd., announces that Mr. R. Quigley, who has been area manager of its Scottish territory for many years, has been appointed home sales manager of its organisation as from October 1, 1961.

MR. AUSTIN W. SCOTT, A.M.I.Mech.E., has been appointed to the board of Armstrong Whitworth (Metal Industries), Ltd. He retains the position he has held for the past two years as works manager of the Jarrow Foundry Division.

MR. DESMOND AMBROSE, who was until recently, manager of the process control division of Constructors John Brown, Ltd., has been appointed manager of the southern division of Fischer and Porter, Ltd. He will operate from the Southern Sales Offices of Fischer and Porter, Ltd. at 205, Station Road, Harrow, Middx.

MR. R. H. WORMLEY, formerly Yorkshire area manager, has now been appointed home sales manager of Associated British Machine Tool Makers, Ltd. He has been succeeded at the Leeds office by Mr. W. G. Ormrod, the new Yorkshire area manager who will be operating from Norwich Union Building, City Square, Leeds, 1 (telephone, Leeds 23219).

TURNER AND NEWALL, Ltd., has appointed as public relations officer to the Group, Mr. W. P. Howard, who, in order to take up the appointment, has resigned his position as publicity manager of Ferodo, Ltd., one of the constituent companies of the Turner and Newall Group. He is succeeded at Ferodo, Ltd. by Mr. P. R. W. Jupe.

MR. FRANK ANSTEY, M.I.Mech.E., has retired from his position as chief engineer at the Wolverhampton factory of The Villiers Engineering Company, Ltd., after twenty-two years with Villiers. His services are, however, being retained as technical adviser to the Group. He has been succeeded as chief engineer by Mr. Frank Will May, A.M.I.Mech.E.

VICKERS, Ltd., announces that a new post has been established, special assistant to the managing director, which has been filled by Mr. A. L. Cooper who relinquished the secretaryship of the company with effect from September 22, 1961. Mr. A. M. Simmers has been appointed secretary of Vickers, Ltd., in succession to Mr. Cooper and controller of administration (a principal officer of Vickers, Ltd.), reporting in this capacity to the director of administration. With effect from the above date Mr. Simmers relinquished the secretaryship of English Steel Corporation, Ltd. and his other appointments and directorships in the E.S.C. Group.

Business Announcements

BRITISH BOILER ACCESSORIES, Ltd., 62–3, Fenchurch Street, London, E.C.3, states that it is to manufacture the Stork de-aerator under licence in the United Kingdom.

ALCAN INDUSTRIES, Ltd., states that its Newcastle upon Tyne area sales office has moved to new premises at Newgate House, Newgate Street, Newcastle upon Tyne (telephone Newcastle upon Tyne 22107).

MAGNETIC DEVICES, Ltd., Newmarket, Suffolk, has been appointed sole concessionaire for the manufacture and sale of the Series 35 remanent relay developed by the Telephone Manufacturing Company, Ltd.

BIRWELCO, Ltd., has made an exclusive agreement with Yuba Consolidated Industries Inc., of Tulsa, Oklahoma, to manufacture and sell Aimco Transaire air-cooled heat exchangers in Europe and the British Commonwealth.

C. A. NORGREN, Ltd., of Shipston-on-Stour, Warwicks., has opened a London office at 39, Eccleston Square, S.W.1. (Tel. Victoria 0891) and a Manchester office at 1, Davenport Avenue, Withington, Manchester 20 (Tel. Didsbury 1899).

ELCONTROL, Ltd., Wilbury Way, Hitchin Herts, announces the conclusion of an agreement with The Siegler Corporation Magnetic Amplifiers Division, of New York, for the exclusive sale and manufacture of Elcontrol products in the United States and Canada.

STEWARTS AND LLOYDS, Ltd., states that a residential hall for students employed by the company was officially opened on September 26 at Corby, Northants. The hall, which has cost in the region of £150,000 provides accommodation for sixty-five students.

CLAUDE LYONS, Ltd., Valley Works, Ware Road, Hoddesdon, Herts, states that as from October 1, all manufacture of "Variac" continuously-adjustable auto-transformers in the United Kingdom will be carried out by The Zenith Electric Company, Ltd., and all sales and distribution by Claude Lyons, Ltd.

CHRISTY AND NORRIS Ltd., Chelmsford, Essex, announces that it has obtained sole United Kingdom agency for the Schugi molasses mixer—a fully automated unit which enables full use to be made of molasses as a compound feed ingredient instead of merely as a binder. The mixer is manufactured by Schuurmans and Van Ginneken of Amsterdam.

THE L. M. ERICSSON COMPANY OF SWEDEN and MARCONI'S WIRELESS TELEGRAPH COMPANY, Ltd., England, have together formed a new company in Nigeria, to be known as the Nigerian Telecommunications Corporation. Initially the new company will have its headquarters at the office and factory premises already established by Marconi's on the Apapa Industrial Estate, Lagos.

HENRY SYKES, Ltd., 53B, Southwark Street, London, S.E.1, has appointed Scottish Land Development Corporation as agent for its pumps and other equipment, in Scotland and the Four Northern Counties. There will be three main service centres—Glasgow, Fife and Newcastle, and Mr. A. K. G. Gilbertson A.M.I.C.E. who is located at the Fife Depot is responsible for the overall operation of the Agency.

F. W. BERK AND CO., Ltd., Berk House, 8, Baker Street, W.1, announces that it has acquired Greensplat China Clays, Ltd., which owns deposits of high grade china clay in the St. Austell area. Grades suitable for the paint, paper and ceramics industries will be distributed through the Company's head office in London, and through provincial offices in Manchester, Glasgow, Swansea and Wolverhampton.

CAWKELL RESEARCH AND ELECTRONICS, Ltd., states that due to expiry of lease at Scotts Road, Southall, Middx., and pending completion of building arrangements to enable the company to move into new premises at Park Royal, its offices have moved to 99, Uxbridge Road, Ealing, London, W.5 (telephone Ealing 6215/7585). The final move of this company to its new premises is expected to be completed within the next few months.

THE PLESSEY COMPANY, Ltd., Ilford, Essex, announces the acquisition of the entire share capital of S.P.E. Company, Ltd., Slough, from the Booker Group. S.P.E. is a subsidiary of the Pulsometer Engineering Company, Ltd., recently acquired by Booker's in conjunction with G. and J. Weir Holdings, Ltd. Plessey states that S.P.E. will continue to operate as an autonomous company within the Plessey Group and no immediate changes are envisaged in product or marketing policy.

Contracts

BLYTHSWOOD SHIPBUILDING COMPANY, Ltd., has recieved an order for the complete reconstruction of a T.2. tanker to a bulk carrier. Barclay Curle and Co., Ltd., will connect the new hull to the stem section containing the machinery.

FOSTER WHEELER, Ltd., has been awarded the contract to design, engineer and construct a 70,000 barrels per stream day refinery, at Reunion Rocks, near Durban in the Republic of South Africa, for South African Petroleum Refineries (Pty), Ltd.,—which is jointly owned by the Royal Dutch Shell Group of Companies and British Petroleum Company Ltd.

VOSPER, Ltd., has received a contract from the Malayan Government to build six fast patrol craft for the Royal Malayan Navy. These craft will be of welded steel construction and have an overall length of 103ft and be powered by Bristol Siddeley Maybach diesel engines to give a speed of 25 knots. Equipment will include two Bofors 40 mm guns, Decca True Motion Radar and Vosper Roll Damping fins.

THE POWER-GAS CORPORATION, Ltd., of Stockton-on-Tees, has been appointed main contractor by Magnesium Elekton, Ltd., for the engineering of a new plant to produce 5000 tons per annum of magnesium at Hopton, near Wirksworth, in Derbyshire. The plant will extract magnesium of 99·9 per cent from local dolomite by a reduction process which has not previously been operated on a commercial scale in this country. The total value of the completed plant is expected to be in the region of £2,000,000.

DORMAN LONG (BRIDGE AND ENGINEERING), Ltd., has received a contract valued at £139,000 for the demolition of the Widnes Transporter Bridge which crosses the River Mersey and the Manchester Ship Canal. The bridge was built in 1905 and consists of approximately 3000 tons of steel and iron. It has been replaced by the new Runcorn-Widnes bridge which was built by Dorman Long and opened on July 21, 1961. Demolition of the old bridge is scheduled to be completed in two years. The engineers are Messrs. Mott, Hay and Anderson, of London.

THE HEAD WRIGHTSON MACHINE COMPANY, Ltd., of Middlesbrough, has received an order from the Finnish metalliferous mining and copper producing company Outokumpu Oy. of Pori, for the supply of a large tube drawbench to be used in the manufacture of non-ferrous tubes, valued at approximately £100,000. The bench is to be of the single chain triple draw type, having a maximum pull of 100,000 lb and capable of drawing tubes up to 150ft in length. It will be provided with special electrical equipment to give infinitely variables speeds of draw up to a maximum of 300ft per minute.

SMITHS AVIATION DIVISION, announce that they received a repeat order, worth £190,000, for Smiths SEP. 2 autopilots and flight instruments for the German Air Force. This type of equipment was originally supplied in 1958 for use in the French-designed Nord "Noratlas" heavy freighters being built under licence in Germany. To date, all "Noratlases" for the German Air Force have been equipped with this autopilot, and with Smiths instrumentation, mainly in the form of altimeters, engine and navigation instruments. One of these "Noratlas" aircraft is being prepared for trials in Germany of the R.A.E.—developed "Autoland" System, which uses Smiths SEP. 4 autopilot and type 4B Smiths Flight System.

THE ENGLISH ELECTRIC COMPANY, Ltd., has received a £6,000,000 order from the Cairo Electricity and Gas Administration for a 120MW extension to the Cairo South Power Station. The existing generating plant is of Continental manufacture. Part of the payment will be in cotton, arranged in conjunction with the international firm of cotton merchants Louis Dreyfus and Co., Ltd. Although English Electric are the main contractors and will co-ordinate the complete project, it is an Anglo-Egyptian enterprise in that Misr Concrete of Cairo have a £750,000 contract for the civil engineering work. The plant is scheduled to be in operation early in 1964. The order covers the complete electrical and mechanical equipment. The two 60MW steam turbines will be made at the Rugby works of English Electric, the alternators, transformers (including the two rated at 75MVA) and 63kV switchgear at Stafford, and the low voltage switchgear and fusegear at Liverpool. The four boilers, each of 441,000 lb per hour capacity, will be manufactured by Simon-Carves, Ltd.

Load Carriers at Frankfurt

The self-loading transporter ABOVE, designed for the removal of disabled cars or other light vehicles, is the latest addition to the wide range of special purpose derivatives of the Austin-engined, front-wheel-driven Tempo commercials. Attached to the frame members carrying the power unit and cab are two steel channel ramps, which can be lowered to ground level by collapsing the rear suspension by means of a manually-actuated hydraulic pump. The car to be moved is winched or driven up and secured by locking plates and chains. The ramps are then raised to the travelling position. The wheelbase is 12ft 10in and the overall length of the car ramps, each 16in wide, is 15ft 9in. The width over the rear wheels is 8ft 2in while the permissible gross weight is 3 tons 6 cwt.

An unusual full forward control heavy duty tipper was the largest German vehicle at the Frankfurt show. The Faun K 30/40 V tipper, BELOW LEFT, for a 32,000kg payload is powered by a turbo-charged Rolls-Royce eight-cylinder diesel engine developing 400 b.h.p. at 2100 r.p.m. The vehicle has an Allison "Torqmatic" transmission with three-stage torque converter. Final drive is through epicyclic reduction gears in the rear wheels, and the tyres are 18.00-33 special 32-ply. The vehicle has Meiller-built hydraulic tipping gear and body, and an unladen weight of 29,000 kg. The overall height is 12ft 6in and the floor height of the one-man cab is 5ft 11in above ground level.

A prototype articulated vehicle suitable for road-rail traffic was shown by Büssing in conjunction with Fahrzeugwerke Kannenberg. The show exhibit (BELOW RIGHT) had an open drop-side body of composite steel-aluminium construction but closed van-type containers will be made as well. Basically the outfit consists of a medium wheelbase Büssing "Commodore" tractor, a tandem axle bogie and a self-supporting body. By means of hydraulically-operated carriers with rubber tracks running in transverse channels fitted above the fifth wheel mounting and above the rear bogie, the body can be transferred laterally to a rail truck or loading bank. An in-built hydraulic jacking system on each of the two carriers enables the body to be raised and lowered, respectively, prior to and after the transfer. The carriers are supplied by the hoses seen between the troughs, and travel with the vehicles. As shown the vehicle was suitable for a 20-ton payload, the unit load favoured by the German Federal Railways. The turntable-mounted transfer gear on the tractor can be removed to accommodate conventional semi-trailers.

CONTINENTAL AFFAIRS

by Our Continental Editor

The International Motor Show at Frankfurt

No. II—(*Continued from page 551, September 29*)

IN our report last week we discussed the economic position of the German motor industry and its influence on world markets, and gave a short survey of the principal trends of Continental automobile engineering as reflected at the Frankfurt show. We now turn to a more detailed description of the latest German cars and some of those foreign models making their first public appearance there. In view of the great number of exhibits we must refrain from mentioning cars which differ from those seen at recent international motor shows in such minor details as the addition of some proprietary equipment or modified body style.

Fig. 1—The Mercedes "300 SE" is distinguished by a light-alloy fuel-injection engine and automatic transmission. The steering is powered hydraulically, the disc brakes assisted by vacuum servo, and the suspension levelled by compressed air

Daimler-Benz, Germany's oldest and best known automobile factory, presented a complete range of its large manufacturing programme of Mercedes cars, commercial vehicles and Diesel engines. The main public interest was evidently focused on the car section : the four-cylinder 1·9 litre types Mercedes " 180 " and " 190 " remain basically unaltered, but the cylinder capacity of the Diesel engined types " 180 D " and " 190 D " has been stepped up from 1·9 litres to 2 litres, resulting in a 5 per cent power increase (55 h.p. at 4,200 r.p.m. in case of the " 190 D."*)

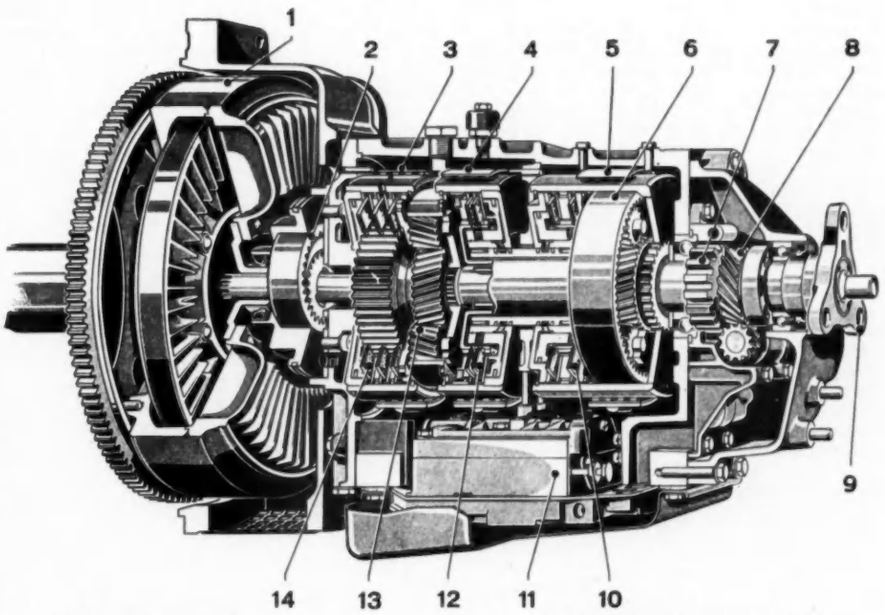
All cars of the type " 190 " and 190 D " now have the same body shell as the six-cylinder Mercedes " 220 " from which they differ in appearance only by a shorter bonnet and by a 2in shorter wheelbase. The body of the type " 220 " also serves for the entirely new model Mercedes " 300 SE," a car characterised by a 3-litre petrol injection engine, an automatic transmission of Daimler-Benz design and manufacture, air suspension, servo-assisted disc brakes on all four wheels and power steering.

None of these features is novel in itself, but the unique combination of all of them in a car, made by a firm with a high reputation for technical merit, is bound to provide an optimum of driving safety, comfort and performance. The new Mercedes can claim to be the most advanced (though, naturally, rather complex) car in the world.

The power unit of the " 300 SE " has a bore and stroke of 85mm by 88mm and a capacity of 3 litres. Basically similar to the 3-litre engine of the Mercedes sports car " 300 SL," it has a chain-driven overhead camshaft, actuating the valves by short followers, seven main bearings, and an oil-water heat exchanger. Intended for a luxury car where a smooth and silent engine is essential, the output has been kept within reasonable limits, amounting to 160 h.p. at 5000 r.p.m. on a compression ratio of 9 : 1. In contrast to the engine of the sports car, the cylinder block of the " 300 SE " is made of aluminium with dry, cast-iron cylinder liners ; this design not only reduces the weight by about 77 lb compared to the cast-iron block, but also improves the heat flow to the cooling water and permits the use of smaller piston clearances. The fuel injection system is similar to that of the " 220 SE " (fully described in THE ENGINEER of September 27, 1957), having a Bosch two-plunger injection pump which delivers the fuel via a distributor block to the inlet port of each cylinder.

The Daimler-Benz automatic transmission has been designed with the aim of reducing the hydraulic losses associated with a torque converter. It comprises a fluid coupling and an epicyclic gearbox ; the four forward ratios and the reverse are effected by two sets of planetary gears which are alternatively actuated by means of three multi-plate clutches and of three band brakes. The gear change is hydraulically controlled in response to engine torque and car speed, but can also be effected at will by an overriding manual control. In the first ratio and reverse both epicyclic gear sets are in operation, one or the other set in the second and third ratio, while in top gear the two sets are out of operation and rotate as a whole at crankshaft speed. An ingenious device ensures that the torque during the gear change is taken up without any noticeable jerk, and it is claimed that the brake bands do not require any re-adjustment. Compared to an equivalent synchronised four-speed gearbox (which—by the way—is not available for the " 300 SE ") the new automatic transmission is only 3in longer and weighs about 30 lb more.

The power-assisted steering gear, also of Daimler-Benz design, combines the advantages of the recirculating ball mechanism with that of the servo system ; the sliding steering nut actuates the control piston of the hydraulic circuit, the required pressure oil being supplied by a belt-driven vane-type pump. The degree of



1—Hydraulic starting clutch.
2—Primary oil pump.
3—Brake band 3.
4—Brake band 1.
5—Brake band 2.
6—Rear planetary unit.
7—Parking block gear.
8—Drive gear for governor and secondary pump.
9—Output shaft.
10—Clutch 2.
11—Shift plate.
12—Clutch 3.
13—Front planetary unit.
14—Clutch 1.

Fig. 2—Automatic Mercedes-Benz transmission

* In this report the engine output is always given in net horsepower, this indicating the output of an engine with all accessories such as generator, cooling fan, water pump, intake filter and silencer, which is actually available at the clutch.

CONTINENTAL AFFAIRS *(Continued)*

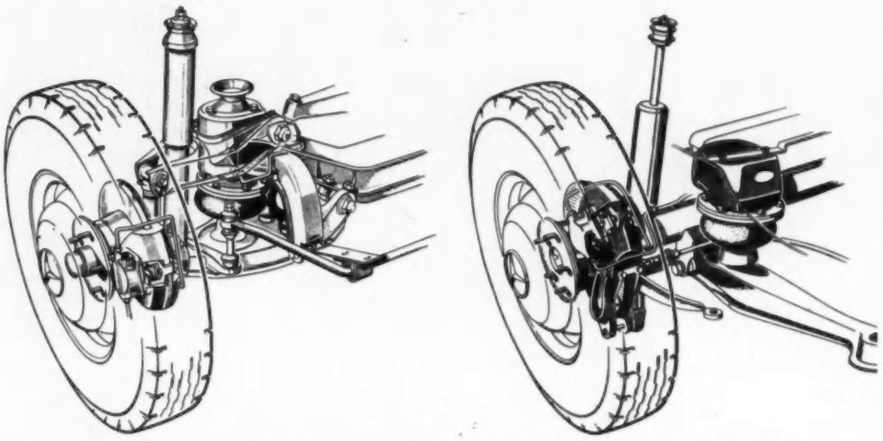


Fig. 3—(Left) Mercedes front wheel suspension with trapezoidal wishbones, disc brake and air suspension. (Right) Rear wheel suspension on single joint swing axle with thrust arms and air suspension, disc brake with lever for braking moment absorption

servo assistance is greatest at parking conditions, but is reduced progressively with increasing speed.

The layout of the air suspension is based on the experience gained by Daimler-Benz with autobuses and coaches, but had to be suitably modified to meet the conditions of the independently sprung low-pivot rear swing axle. The design employs four rubber bellows, each one fitted with an additional air chamber, which are disposed at the front between the lower triangular wishbones and the front cross-member and, at the rear, above the longitudinal thrust arms of the axle tubes. There are two self-levelling valves at the front, one for each wishbone, and a single one at the rear, operated from the midpoint of the stabiliser bar. A reciprocating twin-cylinder compressor, belt-driven over a magnetic coupling from the engine pulley, delivers the air to a 7-litre reservoir and, through a pressure relief valve, to the levelling valves.

The " 300 SE " is equipped with Dunlop disc brakes on all four wheels, servo assistance being provided by a vacuum booster. The calipers of the rear brakes are mounted on short longitudinal torque arms which transfer the brake reactions directly to the chassis frame.

The new car has a wheelbase of 9ft, a track of 4ft 10in and an overall length of 16ft. Its curb weight is about 31 cwt, and a maximum speed of 110 m.p.h. is claimed. Lavishly equipped, this latest addition to the international class of luxury cars should find a ready, though numerically rather limited, market.

The Auto-Union, now amalgamated with Daimler-Benz, showed at their stand, apart from their basically unaltered private cars, some interesting cross-country vehicles, all fitted with the well-known 44 h.p. 1-litre, three-cylinder, two-stroke engine. These cars have four-wheel drive, and are equipped with eight forward and two reverse gear ratios, operated by a floor-mounted gear-shift lever.

An addition to the range of the Auto-Union passenger cars is the D.K.W. " Junior de Luxe," basically similar to the " Junior " which, since its introduction four years ago, has become very popular, particularly in the home market. The cylinder capacity of the de luxe version has been increased to 800 c.c. (compared to the 750 c.c. of the " Junior ") by lengthening the stroke by 2mm, resulting in a 5 per cent higher torque at the unaltered output of 34 h.p.

A valuable contribution to the development of the two-stroke engine is the new " Lubrimat " fresh-oil lubrication system, now supplied to all Auto-Union cars (optionally only to the " Junior ") which replaces the former " petroil " lubrication, that is the ad-mixture of the lubricant to the fuel. The lubricating oil is now carried in a separate tank, mounted on top of the exhaust manifold ; attached to this tank is an oil pump with a variable plunger stroke which is driven from the engine front pulley by a vee belt. It delivers the oil through a pipe line to the intake manifold and injects it into the main jet of a Solex carburetter. The oil, aspirated with the charge, enters the crankcase and supplies the roller bearings of the crankshaft and of the big ends as well as the cylinder liners. A linkage between the throttle and the oil pump adjusts the stroke of the latter so that the oil delivery takes place not only in response to the engine speed, but also to the load. A pressure relief valve with a control switch attached to it indicates any failure in the oil supply by a warning light on the instrument board. The oil consumption is reduced to about 1 per cent of the ordinary fuel consumption compared to the 2½ to 3 per cent consumption which constitutes the optimum attainable with " petroil " lubrication. It is claimed that the " Lubrimat " system completely eliminates the smoky exhaust which used to be one of the major disadvantages of the two-stroke engine.

The centre of public attention at the Frankfurt Show was, without any doubt, the large pavilion of the Volkswagen Works with the interesting exhibits of the basically unchanged, but recently slightly modified, 1·2 litre Volkswagen and the long expected new model, the V.W. " 1500." For some time speculation has been ripe that the 1·2-litre car being an " antiquated and obsolete model " would be replaced by some entirely new " sensational " car. This prophesy—which was never taken seriously in technically informed circles—has certainly been wrong. The V.W. " 1500," though different in styling and layout of the body, is basically a more advanced, more refined and better equipped version of the familiar 1·2 model. It is not intended to replace the smaller car which, according to official statements of the management, "will always remain the mainstay of the production. The 1·5-litre car, designed to cope with the increasing prosperity, is a genuine Volkswagen with the typical construction features of the world's most successful post-war car." Apparently it is not intended to build the V.W. " 1500 " in very large quantities yet ; the present daily production of about 200 cars is to be stepped up in the course of next year to about 500, a comparatively small number compared to the present production of 3500 1·2 litre cars a day.

Reference has been made to the fact that the V.W. " 1500 " is based on the technical concept of the older model. It has the rear-mounted, air-cooled, flat four-cylinder engine, the independent torsion bar suspension front and rear, and the platform chassis with central backbone to which the main body shell is bolted. Although the car has the same wheelbase of 7ft 10½in as the 1·2 litre type it is wider, has a larger window area, and offers comfortable accommodation to four persons. There is more luggage space at the rear as the engine is very compact and low, thus offering the space on top of it as a luggage locker.

The 1·493-litre engine follows very closely the conception of the smaller engine, but the cooling fan is directly mounted on the tail-end of the crankshaft, and all such accessories as the oil-cooler, the side-draught carburetter with air filter, the generator and the ignition coil are mounted at the top and are easily accessible after lifting the boot floor. The elimination of the former belt-drive of the cooling fan, apart from lowering the overall height of the engine to about 16in, has resulted in low fan speed and a considerable reduction of noise. The crankshaft pulley drives the generator only and, in case of a break of the belt, the cooling of the engine is not affected. With a bore of 83mm and a stroke of 69mm the engine, at the low compression ratio of 7·2 : 1, has an output of 45 h.p. at 4000 r.p.m. All the cooling air is drawn through channels in the body into a sealed intake housing, thus reducing the possibility of the air becoming dust-laden.

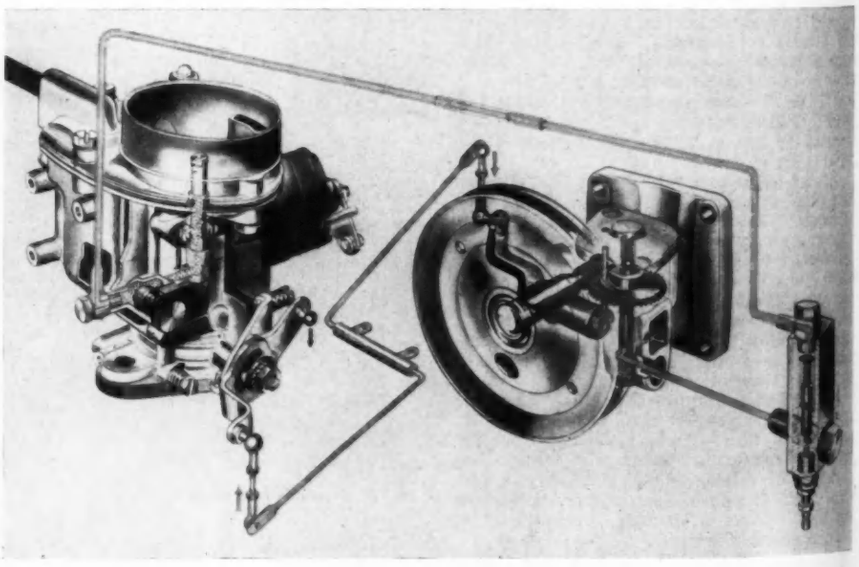


Fig. 4—Fresh-oil lubrication for two-stroke engines of Auto-Union. The oil, delivered by a belt-driven pump with variable piston stroke, is injected into the engine through the main jet of the carburetter

Figs. 5 and 6—(Left) The new V.W. "1500" with 1·5 litre motor is an addition to the programme of the Volkswagen works, but is not intended to replace the 1·2 litre V.W. which still remains the mainstay of the production. (Right) The flat floor over the engine compartment offers a roomy loading space

The four-speed, all-synchronised gearbox and the final drive are housed in one light metal casing; they are almost identical in design to the transmission of the 1·2-litre type, but the whole engine-transmission unit is mounted on a rubber-cushioned subframe for easy removal and improved insulation of the body from road shocks and engine vibrations.

The front suspension differs from that of the 1·2-litre car inasmuch as the whole assembly is cushioned in thick rubber. Instead of the former laminated torsion bars of square section, round-section bars are attached to the lower trailing arms of the wheels; the top trailing arms are linked by a stabiliser bar to induce a certain degree of understeer. The wheel assemblies pivot about ball joints on the upper and lower arms; these four joints are the only ones fitted with grease nipples, all other connections being rubber bushed and requiring no maintenance.

As to the appearance of the car, it can be stated that it is simple without being austere, devoid of any chromium ornamentation and, being definitely stylish and not affected by any passing fashion trends, it should remain modern for a long time to come. Two wide doors give easy access even to the rear seats; the well contoured individual front seats are quite comfortable and are adjustable for rake. A useful safety factor is the locking device for the seat backrests which is automatically released when the doors are open.

The standard equipment, like that of most Continental cars, is very complete; it includes the heater, fresh-air ventilation, an anti-theft steering lock, headlamp flashers, screen washer and variable-speed wipers. All instruments are fitted with padded cowlings to prevent them from reflecting in the windscreen at night.

With an overall length of 13ft 10in and a width of 5ft 3in the car suits the conditions of modern city traffic, and large tyres, 6·00×15, should prove useful for riding comfort and long tyre life. It is claimed that the car, which weighs about 19 cwt, is capable of a maximum speed of 78 m.p.h. and of a cruising speed of well over 70 m.p.h.

Summing up our impression of the V.W. "1500," it is not difficult to predict that this eminently practical and in all details well designed car will prove to be a very strong competitor to most European cars of the 1·5-litre class.

The Bayerische Motoren Werke (B.M.W.), best known to the public as manufacturers of motor-cycles and small cars, based on motor-cycle technique, have also been making fast luxury eight-cylinder cars for some time. Production figures, however, have been small (less than 700 last year), and it seems surprising that the firm, which in pre-war years had a high reputation as makers of fast touring cars, should again enter this particular market. There is, however, some justification for this rather bold enterprise of trying to compete with well-established German and foreign cars in the already overcrowded 1·5-litre class. Most of the quantity-produced cars of this class —with a few exceptions only — are of entirely orthodox design, having push-rod operated valves, rigid rear axles and leaf springs, i.e. technical features hardly compatible any more with the modern idea of a both fast and comfortable touring car of sportive character. The B.M.W. "1500" has been designed to fill this gap and, to judge from the favourable reception which the first prototypes of this new 1·5-litre car received, a definite, though probably not very large, demand can be predicted.

The B.M.W. "1500" is a well-styled, four-door, four to five seater saloon of integral all-welded construction fitted with a high-efficiency 1·5-litre, four-cylinder engine, all-synchronised four-speed gearbox with floor-mounted gearshift lever, and independent wheel suspension by coil springs front and rear.

The water-cooled engine of 82mm bore and 71mm stroke and a compression ratio of 8·2 : 1 has an output of 75 h.p. at 5000 r.p.m. and a peak torque of 88 lb ft at 3000 r.p.m. It is mounted at an angle of 30 deg. to lower the centre of gravity and afford a low tapering bonnet.

The engine, the only water cooled o.h.c. unit of the 1·5-litre class, has the following design features: a counterbalanced crankshaft carried in five main bearings, hemispherical combustion chambers, and a chain-driven overhead camshaft which operates the inclined valves by rocker arms. The fan-shaped intake manifold is water-jacketed, and the charge can be preheated by air drawn from the region of the exhaust manifold through a thermostatically controlled butterfly valve.

The engine torque is transmitted via a single dry-plate clutch to the four-speed gearbox which has "split ring" synchronisers (System Porsche) for all forward ratios. The gearbox casing has an unusually long rear extension to reduce the length of the propeller shaft. The final-drive casing is attached to the body frame by means of thick rubber cushions, and double-jointed half shafts lead to the independently sprung road wheels.

The front suspension resembles that of a Peugeot; at the rear each wheel is suspended on a forked trailing arm with its two chassis pivots placed at an angle of 20 deg. relative to the transverse axis. There is a torsion-bar stabiliser at the front, and the rear springs are assisted by hollow rubber springs. There are drum brakes at the rear and, at the front, disc brakes without any servo assistance.

The car has a wheelbase of 8ft 5in, a mean track of 4ft 5in and an overall length of 14ft 7in; it weighs dry about 19 cwt and is designed for a maximum speed of 95 m.p.h. So far, the B.M.W. "1500" is still in the prototype state, but is is planned to go into production by 1962.

We conclude our description of the latest German cars at the Frankfurt Show with a short survey of some interesting engines which are either still in the experimental stage or, built for specialised purposes only, will not be available for some time.

The Glas 1-litre engine, constructed for the Glas (Goggomobil) coupé "S-1004" is a rather unorthodox power unit: the crankshaft is carried in five main bearings, and the central overhead camshaft is driven by an exposed toothed belt of synthetic rubber. Steel wires,

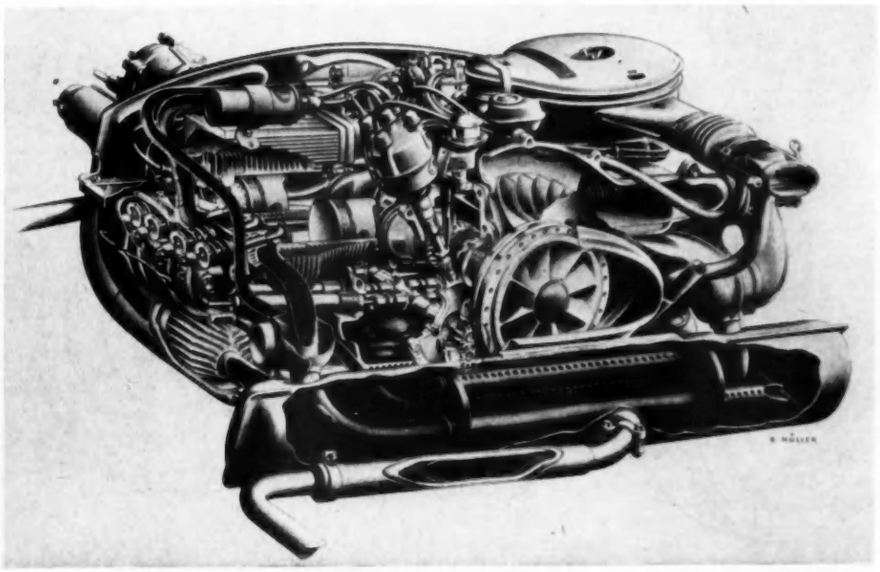


Fig. 7—The low overall height of little over 16in has been achieved mainly by arranging the cooling fan at the rear end of the crank shaft of the V.W. "1500"

CONTINENTAL AFFAIRS *(Continued)*

Fig. 8—The new four door BMW 1500 with water-cooled four cylinder in-line engine giving 75 b.h.p.

embedded in the rubber, prevent the belt from stretching and ensure the correct pitch of the teeth. Although toothed belts have been used for the transmission of a minor torque for some time, their application to a camshaft drive is certainly novel. The Glas power unit, of 72mm bore and 61mm stroke, with a compression ratio of 8·5 : 1, has an output of 42 h.p. at 4800 r.p.m. and a maximum torque of 50 lb ft at 2500 r.p.m. The valves in the hemispherical light-metal cylinder-head are set at an included angle of 30 deg. and are actuated from the belt-driven camshaft by rockers. Should this original camshaft drive really prove successful, it might easily stimulate the increased use of overhead camshafts for other than high efficiency engines.

Another interesting engine is the flat eight-cylinder engine of Porsche, developed for use in the firm's latest Formula 1 racing car. The air-cooled 1·5 litre, of 66mm bore and 54·6mm stroke, has two horizontally opposed banks of four separate cylinders, bolted to the vertically split crankcase which carries the crankshaft in five plain bearings. Each row of cylinders is covered by a common light-metal cylinder-head which is cast integral with the camshaft housing. The inclined valves, two for each cylinder, are directly operated from two gear-driven overhead camshafts, and the large cooling fan, horizontally mounted on top of the crankcase, is also driven by a bevel gear. There are two sparking plugs for each cylinder, fed from two distributors, arranged at the top of the crankcase at an included angle of 90 deg., and four carburetters with twin air-intakes. Designed for a maximum speed of about 10,000 r.p.m. the engine, on a compression ratio of 10 : 1, is expected to have a maximum output of 175 h.p.

A prototype of the N.S.U. Wankel engine, having a capacity of 400 c.c. per chamber, was shown mounted in a "Prinz" sports car to demonstrate the suitability of this very small and compact new power unit for rear engine vehicles. The Wankel engine, evidently, is still in the development stage, and reliable information about its output and general performance was not obtainable.

We now turn to the foreign exhibits which, as has already been mentioned, greatly outnumber the German exhibits, at least in the number of different types.

The French contingent, represented by the four main manufacturers Renault, Citroen, Simca and Peugeot, showed a very comprehensive range of vehicles, some of which seem to have a definite appeal to German customers. Although the import of French cars into Germany is not great (about 46,500 were imported in 1960), there is reason to believe that the gradual lowering of the tariffs between the member states of the European Common Market is already stimulating mutual sales between France, Germany and Italy, all countries with well developed motor industries of their own. French cars; particularly in demand in Germany are the small water-cooled, four-cylinder Renault models "Dauphine" and "Floride" and the various versions of the 1·3-litre Simca range, in other words cars of a design and style not fully covered by the German production programme.

Public attention was mainly centred around the French novelties at the show, the Citroen "Ami 6" and the Renault "R 4," both of which were favourably received. The Citroen "Ami 6," the mechanically improved and better styled 600 c.c. version of the ingeniously designed but rather ugly type "2 CV," has already been reviewed in THE ENGINEER of May 26 last. The Renault "R 4" and its "de luxe" version the "R 4 L" which made their first public appearance at this year's Frankfurt Show are in many ways unorthodox vehicles which deserve to be fully described.

The Renault "R 4" is a five-door, four-seater, front wheel-drive saloon, powered by a 750 c.c. water-cooled, four-cylinder engine. It offers comfortable transport for four people with a large luggage locker or, alternatively, after the removal of the rear seats, provides a spacious

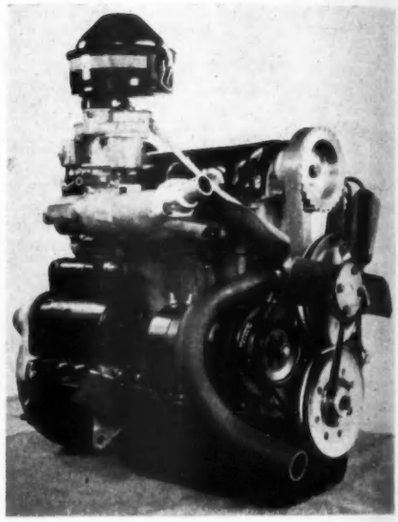


Fig. 10—Glas 1-litre engine; note the external belt drive to the overhead camshaft

platform behind the front seats; the luggage space is easily accessible through the top-hinged fifth door at the rear, even with all seats in place. The car is designed to replace the former "4 CV" rear-engine car which, since its introduction in 1946, has become one of the most popular French cars with sales well exceeding the 1,000,000 mark. The "R 4" is an entirely functional car of rather utilitarian appearance. However, the aim of the designer, namely to achieve the optimum space utilisation for a given wheelbase and track, and to obtain a flat unobstructed floor, has been realised in a very ingenious way. It is obvious that in these circumstances the former rear-mounted power transmission unit had to be shifted to the front, a method which had already been used with success in the Renault "Estafette" delivery van, described in THE ENGINEER of October 1, 1959.

The main structure of the "R 4" comprises a stiff flat platform, reinforced by box-section length- and cross-members, to which the all-welded skeleton of the body is bolted; the detachable front and rear wings can easily be repaired or replaced. The suspension at the front is by longitudinal torsion bars, attached to the lower wishbones, with telescopic dampers and a transverse stabiliser bar. The rear suspension employs transverse torsion bars, located side by side in the same horizontal plane, which are linked to the box section trailing arms of wheels; the telescopic dampers at the rear are

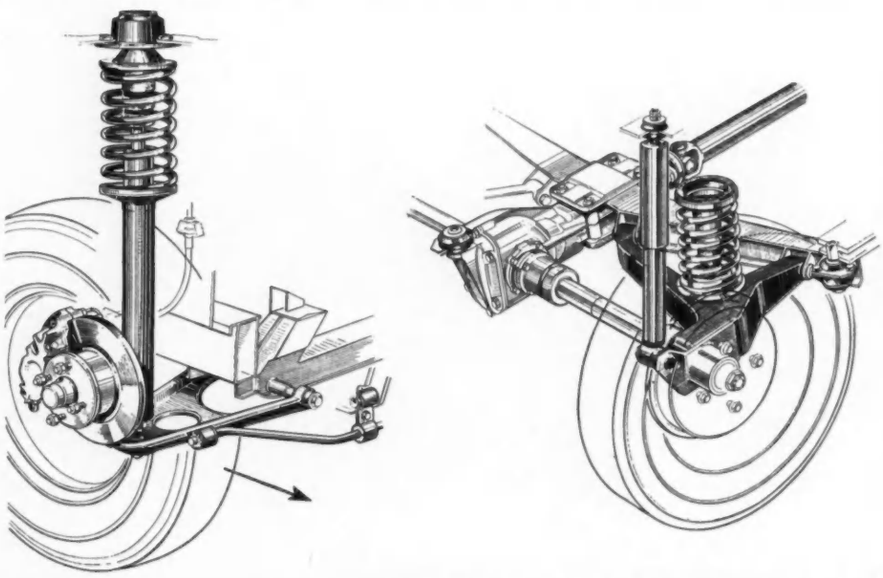
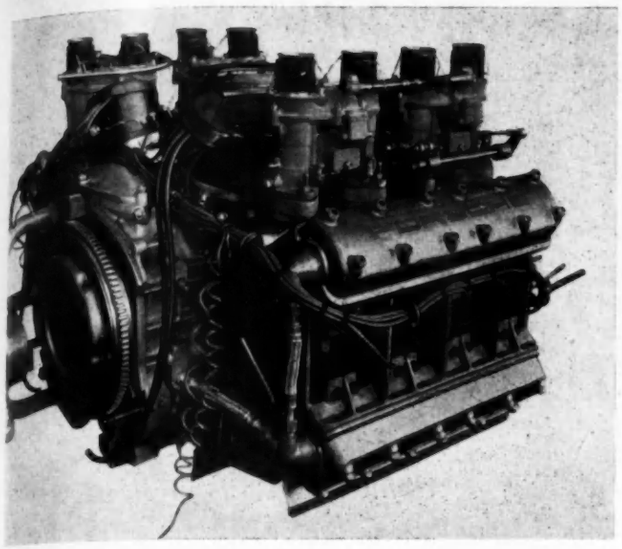
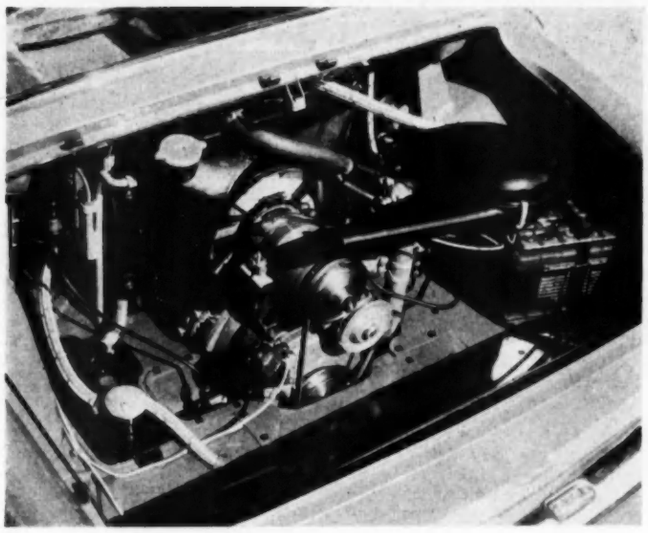


Fig. 9—(Left) Front suspension of the 1·5 litre BMW 1500. Silent rubber bushes and rubber blocks are used throughout. (right) Rear suspension; the independently sprung rear wheels are insulated relative to the car body by substantial rubber blocks. A hollow rubber spring assists the coil spring over a considerable length of the working travel





Figs. 11 and 12—(Left) Eight-cylinder, horizontally-opposed, air-cooled o.h.c. engine with camshafts driven by bevel gears, similar to "Carrera" engine. (Right) Wankel engine in N.S.U. "Prinz" car. Notice that the contact breaker is contained within a distributor, and observe the transparent case of the accumulator

horizontally mounted to ensure a sufficient ground clearance. A surprising feature of the side-by-side arrangement of the transverse torsion bars is the fact that the wheelbase at the right side is about 2in longer than that at the left. The steering, as in most front wheel-drive cars, is by a rack-and-pinion mechanism with a friction damper and a centralising coil spring. All suspension joints front and rear are either rubber bushed or, like the four swivel ball-joints at the front, prelubricated with silicone grease and hermetically sealed; none of these joints require any maintenance. A spring-loaded valve in the hydraulic brake circuit limits the brake effort to the rear, thus preventing their locking.

The 750 c.c. engine is a modified version of the former "4 CV" engine; it follows conventional Renault practice in having a cast-iron cylinder block, wet liners and a light-metal cylinder head—the output, on a compression ratio of 8·5 : 1, amounts to 21 h.p. A unique feature of the engine, and one which is likely to be adopted by other manufacturers, is the hermetically sealed water circulation system which requires no topping-up. The radiator, at assembly, is filled with water containing an anti-freeze mixture, and an expansion tank temporarily accepts any overflow from the radiator; it partly fills under running conditions, and the overflow is drawn back into the radiator when the fluid contracts.

The three-speed gear, with synchronised second and third ratios, and the final-drive are housed in one light-metal casing in front of the engine. The torque is transmitted to the road-wheels by means of half shafts having constant-velocity joints inboard and double Hooke's joints outboard.

The equipment and the instrumentation of the car are simple, but adequate: the tubular seat frames are covered with an overlay of synthetic material on a sprung fabric and rubber base; heater and fresh-air ventilation are standard equipment. The "R 4" has a mean wheelbase of 8ft 1in, a track of 4ft, and an overall length of 11ft 9in; its curb weight is about 11½ cwt.

The new Renault, far from being a luxury car, is an eminently useful yet comfortable means of transport; it seems to be the closest approach to a vehicle requiring practically no maintenance, apart from the periodical change of engine oil and gearbox oil. It represents a remarkable example of advanced automobile engineering, and is likely to become a strong competitor to most cars of this particular class.

Italy, the third automobile producing partner of the Common Market countries, produced 595,000 cars in 1960 of which 198,000 were exported. Germany took the comparatively large number of 72,000 cars, 34,000 of which were assembled in Fiat's German subsidiary company at Neckarsulm. As in the case of German imports from France, here again the imported cars were mainly those not included in the German production programme, i.e. the small water-cooled, four-cylinder, 800 c.c. and 1·1-litre models of Fiat and the well-styled 1·3-litre "Giulietta" sports cars of Alfa Romeo. Italy, apart from these two firms, was also represented by Lancia, Ferrari and Maserati.

Fiat which, with a production last year of about 500,000 cars, (85 per cent of Italy's total production) completely dominates the Italian market presented their comprehensive manufacturing programme; it includes, apart from a 500 c.c., air-cooled, twin-cylinder model, not less than five water-cooled, four-cylinder types, ranging from ·8 up to 1·5 litres capacity, and two six-cylinder models of 1·8 and 2·3 litres. With the exception of the 500 c.c. and 800 c.c. rear-engine models all the cars are of orthodox conception.

Public interest at the Fiat stand was mainly attracted by the new Fiat "1300" and "1500," actually one and the same car fitted with either a 1·3 or 1·5-litre engine; the car is designed to fill the gap between the new six-cylinder models and the "1100" and "1200" cars which continue in production. The new Fiat is a comfortable and well-equipped, four-door, four-seater saloon of typical Italian styling, only 13ft 3in long. The stressed steel body carries at the front a conventional wishbone-and-coil spring suspension, and at the rear semi-eliptic leaf springs; the formerly used rear suspension of coil springs in conjunction with cantilever leaf springs—for taking the drive and the brake reactions—has been discontinued. Both the front and rear suspension are fitted with double-acting telescopic dampers and stabiliser bars. The engine is mounted at an angle relative to the vertical plane, and the two-part propeller shaft has a rubber-cushioned centre bearing. The two alternatively fitted engines have a bore of 72mm and 77mm respectively, and a stroke of 79·5mm; the 1·3-litre engine has an output of 61 h.p. and the 1·5-litre an output of 67 h.p., both at the same speed of 5400 r.p.m. and on the compression ratio of 8·8 : 1. The comparatively high output of about 45 h.p. per litre is due to an aluminium cylinder-head with fully machined combustion chambers and inclined, push-rod-operated valves; the inlet and exhaust ports are arranged at opposite sides of the engine. According to recent Fiat practice all engines are fitted with a centrifugal oil cleaner incorporated in the front pulley, and an additional by-pass filter. The car is fitted with Girling disc brakes (without servo assistance) at the front, and with finned drum brakes at the rear. It has individual front seats, adjustable for height and rake, dual head lamps and, an additional light for reversing.

The "1800" and "2300" Fiat models are roomy and luxuriously equipped cars, available either with a 1·8-litre or a 2·3-litre six-cylinder engine; they are very similar in their overall design and construction to the above described

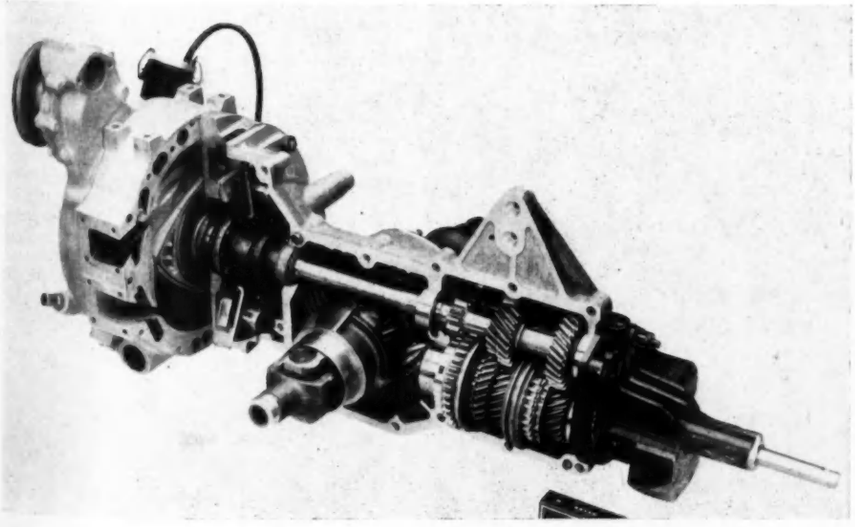


Fig. 13—Prototype power unit of a N.S.U. car fitted with Wankel engine: noteworthy are the conventional proportions of the reduction gears

CONTINENTAL AFFAIRS *(Continued)*

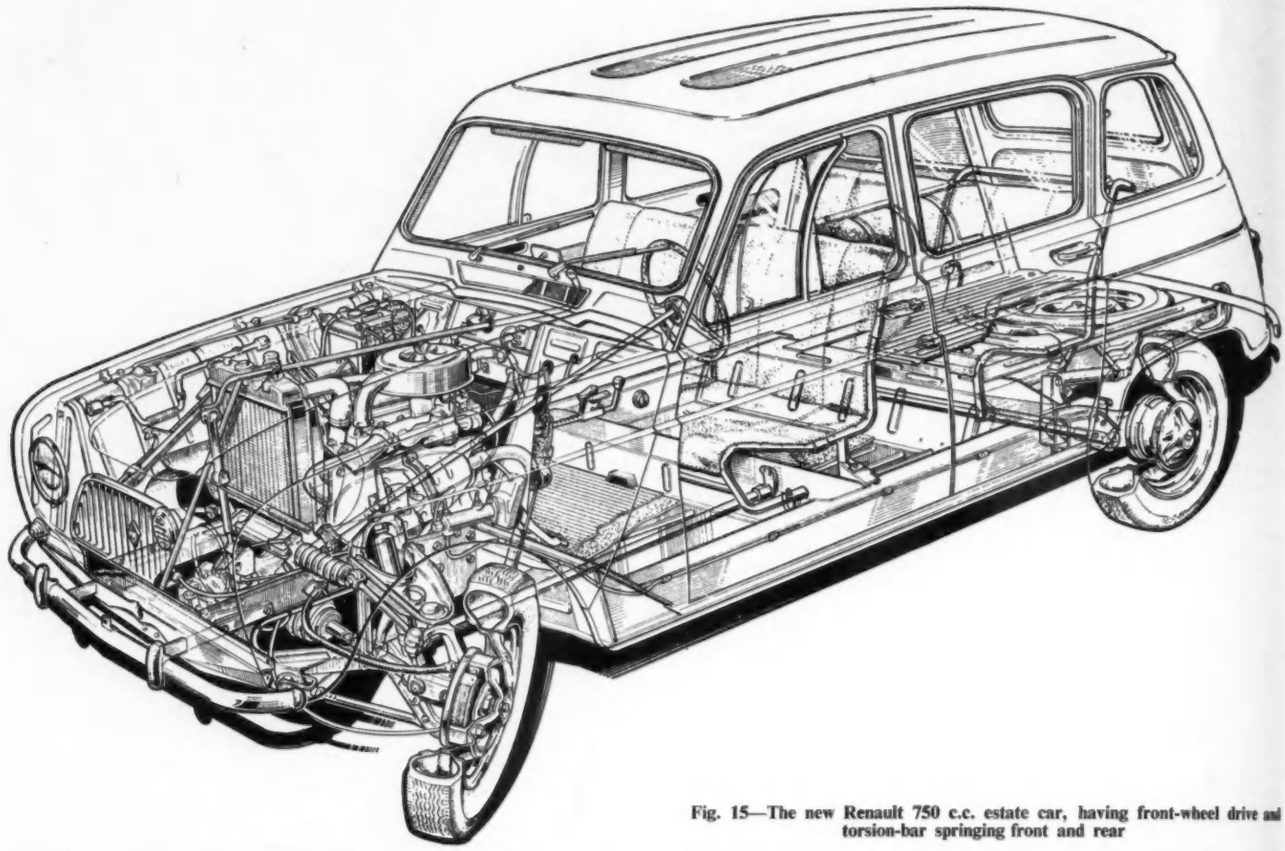


Fig. 15—The new Renault 750 c.c. estate car, having front-wheel drive and torsion-bar springing front and rear

1·3/1·5-litre types. The engines also are basically six-cylinder versions of the smaller four-cylinder power units, having the same stroke of 79·7mm and a bore of 72mm and 78mm respectively ; most components of the four-cylinder and the six-cylinder are interchangeable. The output of the engines, on the standard compression ratio of 8·8 : 1, is 81 h.p. for the 1·8-litre and 105 h.p. for the 2·3-litre engine ; a special version of the latter engine, intended for a 120 m.p.h. sports coupé (see page 550 *ante*), is available with two carburetters and a compression ratio of 9·5 h.p., and is designed for a maximum output of 120 h.p. All six-cylinder engines have belt-driven cooling fans equipped with thermostatically controlled electromagnetic couplings. In contrast to the "1300" / "150J" cars the " 1800 "/" 2300 " models are fitted with vacuum-assisted Girling disc brakes on all four wheels.

It has already been mentioned that the British contingent, obviously with an eye on the proposed entrance into the European Common Market, was very much stronger than that of any other country, and included practically all British makes. Not represented were only the Vauxhall cars which are not sold in the German home market, this being the territory of Opel, the other European subsidiary of the General Motors Corporation.

Among the British cars which received much attention was the E-type Jaguar which, publicly shown in Germany for the first time, was generally appreciated as an excellent example of modern automobile engineering. Technically minded visitors to the Jaguar stand were evidently impressed by such features as the light but strong body structure, the layout of the all-independent suspension and the servo-assisted brake system, the electric cooling fan and the petrol pump immersed in the petrol tank.

Another car which was favourably received was the Ford " Capri " two-seater coupé (with two occasional rear seats), basically a modified version of the recently introduced Consul " Classic," this latter model not being exhibited at Frankfurt. The flat rear window of the " Classic," reminiscent of its " Anglia " precursor, has been replaced by a curved one, and the roof line has been lowered. By this restyling the appearance of the " Capri," compared to that of the " Classic," has been greatly improved, and the new two-seater coupé, having individual, longitudinally adjustable front seats, offers very comfortable accommodation. The capacity of the 1·4-litre engine is considered adequate and to be in accordance with the Continental requirements for a light two-seater touring coupé.

The reaction, however, of the Continental public to the bread-and-butter line of the industry, namely the medium-sized saloon of the 1·5-litre class, appeared to be one of indifference. Prospective buyers, not familiar with the peculiar structure of the British motor industry and entirely devoid of the strong brand loyalty of British motorists, seemed to be rather bewildered when confronted with about one dozen different makes at almost identical price, evidently similar in performance, and of almost identical appearance. They might well ask whether such a variety is really necessary, and might come to the conclusion that the interests of customers overseas would be better served by a more limited range of choice which should improve the essential service facilities.

Fig. 16—The five doors of the Renault " R4 " give easy access to the seats and to the luggage space

Construction of Milan Underground

A 12·5km-long underground railway is at present under construction in Milan. This line forms the beginning of an underground transport system of 36·5km length. Extensions into the outer suburbs may be built later. Line No. 1 crosses the city centre from approximately west to east and then runs in a north-easterly direction. Six-coach trains holding nearly 1300 passengers will carry up to 20,000 passengers per day, at a maximum speed of 80km.p.h. Average distance of the stations will be 600m, and a mean speed of 30km.p.h. including stops is envisaged. The cut-and-cover construction of the tunnels employs a method developed by the I.C.O.S. Company of Milan, in which a bentonite slurry is used for hydrostatically shoring up the trenches for the tunnel walls. The walls are concreted, after which the excavation for the roof is carried out. Once the roof is built, the road is immediately restored, thus minimising the disruption of traffic. The tunnel itself is then completed underneath without further difficulty.

LIKE other large cities, Milan has for some years past seen its traffic grow at an increasingly rapid rate, due largely to the growing daily movement of people between their homes in the suburbs or in neighbouring towns, and their places of work in the central districts. In 1958, Milan counted a population of 1,400,000 of whom a considerable percentage required transport to get to work. In addition, some 200,000 people came in daily from outside the city; at certain times of the year, e.g. at Christmas, this figure might well be doubled.

It was concluded that the threatening congestion could best be relieved by an underground railway system. Already in 1953 the municipality had submitted to the Ministry of Transport plans which comprised an outline of the proposed network, and the project for Line No. 1 which was to be carried out first. Two years later, these plans were approved by the government subject to certain changes.

A municipally controlled company, Metropolitana Milanese S.p.A. (MM) was set up in 1955 and given the task of carrying the project into effect and later operating the new railway. It produced a modified version of the project towards the end of December, 1956, which was ministerially approved the following February.

Work on the first section was begun in June, 1957, but it was not until September, 1958, that the plans for the whole line were finally completed and approved. Between September, 1957, and July, 1961, 10km out of approximately 12·5km of Line No. 1 were structurally completed. It is hoped to have the first trains running by the second half of next year or early in 1963.

The general scheme is shown in Fig. 1. There will eventually be four lines. No. 1 extends from Piazzale Lotto to Viale Monza, approximately 12·5km in length, with a 2km-long branch from Pagano Station to that of Giovanni dalle Bande Nere. Line No. 2 is planned to run between Lambrate Station and Porta Ticinese, over a distance of 8·5km. The 5·5km-long Line No. 3 (Viale Lunigiana to Via Solari) and the 8·0km-long Line No. 4 (Piazzale Firenze to Piazza Medaglie d'Oro) complete the layout as at present envisaged. It will be realised from our map that plans for Lines 2 to 4, as well as the question of extensions, are still very much in a state of flux.

The carrying capacity of Line 1, with a ninety-seconds train sequence, will be 20,000 people per day, and Lines 1 and 2 together will be able to transport 50,000 people per day. Trains will consist of six carriages, each capable of holding 213 persons (twenty-six seated, 187 standing). The specifications are shown in Table I.

The carriages, which will have a tare weight of approximately 30 tonnes and a laden weight of about 45 tonnes, will run on two two-axle bogies fitted with one 90kW motor per axle. Acceleration is limited to what is compatible with comfort, particularly in view of the large proportion

TABLE I.—*Specification for Carriages of Milan Underground*

Length over buffers	17·54m
Width	2·85m
Height above rails, laden, excluding pantograph	3·50m
Kingpin distance	11·10m
Wheel diameter (new)	0·82m
Number of two-axle bogies	Two
Number of traction motors (one per axle)	Four
Power per motor	90kW
Motor speed (maximum field)	1430 r.p.m.
Motor speed (minimum field)	2300 r.p.m.
Weights :	
Body	13,800 kg
Two bogies	10,540 kg
Electric equipment	5660 kg
Tare	30,000 kg
Laden weight (approximate)	45,000 kg
Performance :	
Acceleration (maximum)	1·5m/ sec²
Deceleration (maximum)	1·5m/ sec²
Maximum speed	80km.p.h.
Average speed, including twenty-second stops at stations	30·4km.p.h.
Specific power consumption	84W-hours per tonne-km

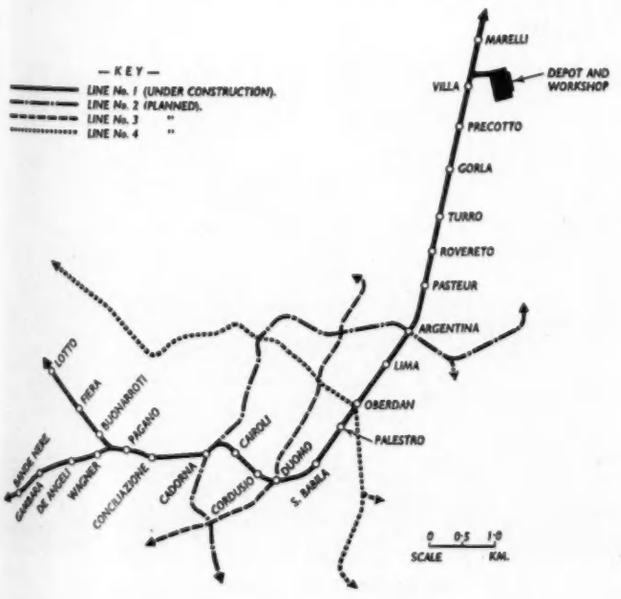
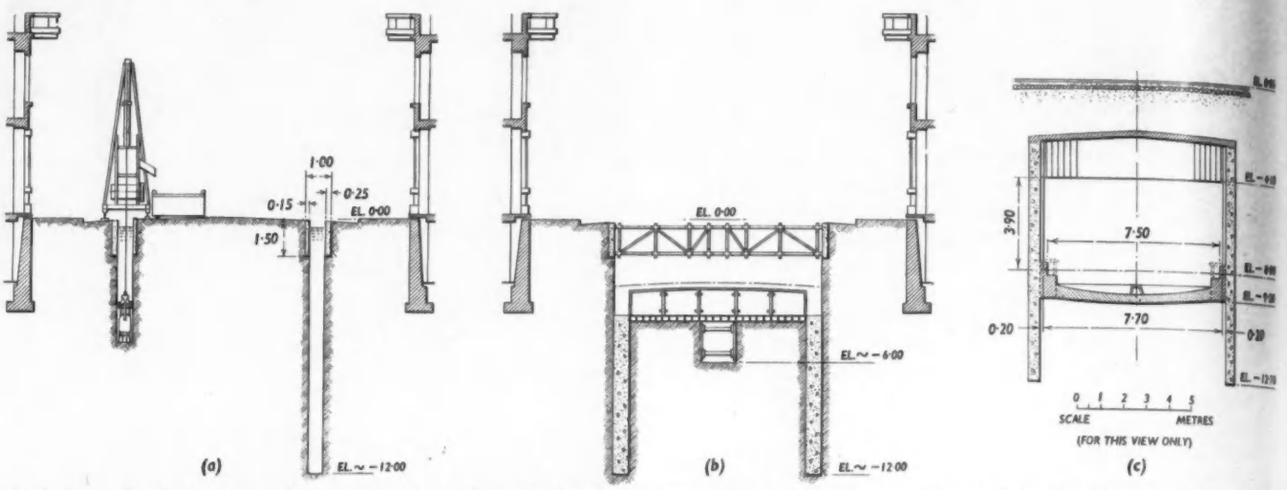


Fig. 1—Milan underground railway

Fig. 2—Special grab for cutting trenches for tunnel walls

CONTINENTAL AFFAIRS *(Continued)*



(*a*) Two approximately 12m deep trenches are excavated, using a special grab guided between concrete walls. A bentonite filling prevents the trenches from collapsing.

(*b*) After inserting the reinforcement, the bentonite is displaced by concrete. The top is excavated and the shuttering for the tunnel roof and roof beams is positioned.

(*c*) Typical tunnel section. The road can be restored without having to wait for the excavation and completion of the tunnel.

Fig. 3—Method of tunnel construction

Fig. 4—After the walls have been concreted, the top of the tunnel is excavated. Here, the sides are supported with tubular struts placed diagonally (Cadorna Square)

The traditional method of "cut-and-cover" therefore had to be resorted to, but this has the great disadvantage of interrupting street traffic for considerable periods. However, it was found possible to reduce interference with traffic to a minimum by applying an ingenious system of construction developed by the I.C.O.S. company of Milan.* Briefly, the method consists in first building the tunnel walls, then the roof and finally excavating the tunnel underneath the roof while the road is already restored to traffic. For constructing the walls, deep, narrow trenches are dug on either side which are prevented from collapsing by filling them with a watery slurry of bentonite with the addition of an activating agent; the slurry has a specific gravity of 1·11. Afterwards, reinforcements are inserted and the walls are concreted to the height of the future tunnel roof. Until then much of the street can, if necessary, still be used by the traffic. Next, the surface between the two trenches is excavated to a small distance below roof level, so as to make it possible to position shuttering for the roof and to withdraw it from underneath when the concrete has

* See also THE ENGINEER, October 28, 1960, page 698.

of standing passengers, and has been set tentatively at 1·5m/sec². With an average distance of about 600m between stations and stops of twenty seconds, an average speed (including stops) of approximately 30km.p.h. will be achieved. This implies a maximum speed of 80km.p.h. Coaches will have on each side four sets of double sliding doors. The trains will be made up of three two-car sets which will have driving cabs and pantographs at the ends, and be semi-permanently coupled at the centre. Further details are still being studied.

Estimated cost per kilometre for Line No. 1 is as follows: Stations and tunnel (structural work only), 1000 million lire, plus 30 per cent for re-routing of services (principally sewers and post office and power cables); completion of stations, track, signals, and rolling stock, 1000 million lire; total, approximately 2300 million lire per kilometre.

TUNNELS

In the alluvial sands and gravel underlying Milan, tunnelling near the surface would have been too risky and expensive, while deep tunnels —which would avoid cables and sewers, but, on the other hand, greatly lengthen the distance between the street and platforms—were difficult or impossible to construct because of the presence of ground water at depths below 16m.

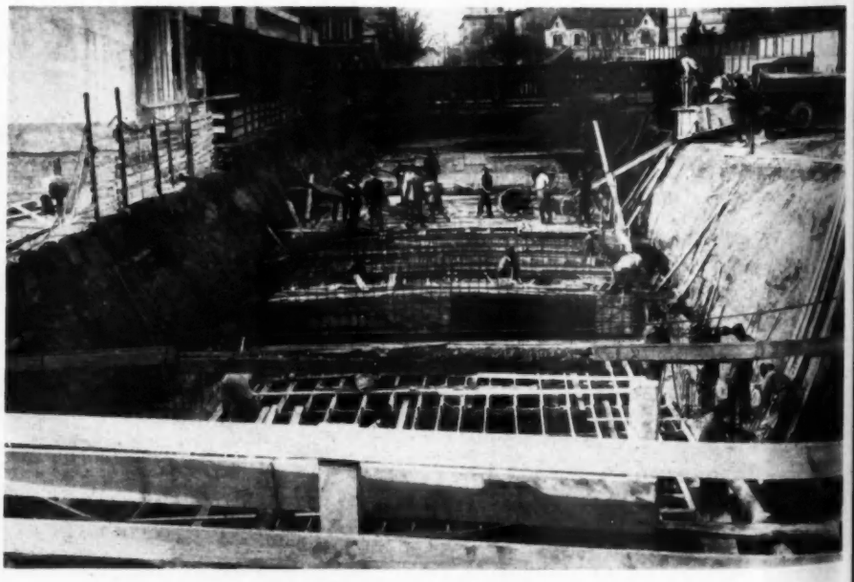


Fig. 5—Placing of the tunnel roof (Giotto Street)

Fig. 6—Structurally completed portion of tunnel. A double "Gunite" finish is applied to the walls where necessary

hardened. The space above the roof can then be filled back and the road restored while the tunnel is excavated under the protection of the walls and roof.

Fig. 3 illustrates the procedure. Guide trenches 1m wide and 1·5m deep are excavated by normal methods and provided with concrete walls, 0·15m thick at the inside face, and 0·25m at the outside face, leaving a clearance of 0·6m between them. This gap guides the grab of the excavator (Fig. 2). The grab is a special design, and enables a very accurate trench to be dug to a depth of the order of 12m below street level. Excavation is carried out in sections of 5m lengths. The jaws of the grab have a radius of action of 0·9m, so that the grab, which is suspended from a rope, excavates a section 1·8m long. Two such lengths are dug, and then the material left standing—two thicknesses of approximately 0·70m each—is cleared away. Throughout, the workings are kept filled with bentonite by maintaining the level in the trench at just below that of the surface. The bentonite is displaced into the new sections by the concrete so that only a small amount of make-up slurry has to be added to allow for losses. These are in fact extremely small as the bentonite seals any interstices in the soil and renders it impermeable.

When digging has been completed over a length of 5m of the trench, it is separated from the next section which is about to be dug by a steel pipe of 0·4m diameter inserted vertically. The reinforcement is then lowered into the trench and positioned, after which concrete is funnelled through a tube which is raised and shortened section by section as the concrete rises in the trench. Concreting continues to a level of approximately —3·5m which is more than is finally required. However, allowance has to be made for the fact that the top portion of the concrete is unsound through mixing with bentonite, and this layer has to be hacked away before the roof can be poured. After the concrete has set, the tube partition is withdrawn, leaving a concave end face so that a semi-cylindrical joint is formed when the next section is poured. The rate of completion is about 2m to 2·5m per day.

When a sufficient length of wall—100m to 300m—has been concreted in this manner on either side of the road, the intervening soil is excavated to somewhat below the level of the roof beams. A longitudinal trench in the centre of the excavation gives access to the underside of the shuttering which is then set up for pouring the roof and the beams.

The wide trench for the roof naturally requires to be supported, either by means of tubular frameworks as in Fig. 3 (*b*) or by tubular struts as in our title illustration (which shows the site in the Corso Vittorio Emanuele near the Dome), or by diagonal struts as in Fig. 4.

Fig. 5 shows the scene in Giotto Street during the placing of the tunnel roof. When the roof concrete has hardened, the top is filled back and the road restored to traffic. The total time during which road traffic is partially or completely interrupted is approximately three months. A major problem in the work was the presence of thousands of water and gas mains, post office cables, power cables and sewers. As far as possible these services were transferred to the pavement areas, or in the case of stations, were re-laid ringwise round the station areas. Under the protection of the roof, the tunnel could then be excavated without danger or difficulty. Finally, the concrete floor of the tunnel was completed. Fig. 6 shows a finished gallery.

The clear width and height are, respectively, 7·5m and 3·9m, permitting the installation of two tracks suitable for 2·85m-wide rolling stock, with a distance of 3·45m between track centres.

The minimum track radius will be 135m (except in the spur to the depot where it will be reduced to 70m).

Stations

Much attention has been paid to the layout of the stations, on which the efficient operation of an underground railway so largely depends. In conformity with the proposed length of the six-coach trains, the platforms are 106m long. This will enable the line to carry 40,000 passengers or more per hour in each direction. Access to the platforms is over stairways from an underground booking hall. The presence of the booking hall underneath the road surface still leaves adequate space for crossings of the various services. Exit from platforms to booking hall is over stairs which for reasons of safety have twice the width of those on the access side. There will be sufficient space in the outer parts of the booking hall for people to use the station adits as pedestrian subways. Figs. 7 and 8 show respectively the booking halls at Cairoli and Fiera stations.

Inauguration of Stalingrad Power Station

The official inauguration of the "Volga" hydro-electric power station at Stalingrad took place on September 10. Stalingrad is the third power station on the Volga built since the war, the others being at Gorky and Kuibyshev. With an installed capacity of 2500MW in the form of twenty-one 115MW sets, it is the world's largest hydro-electric station. Since its first units came into service, it has generated 12,500 million kWh. Annual output of the complete station is from 11,000 to 14,000 million kWh, depending on the water flow (average 1·1 million gallons per second). The dam, which rests on a bed of sand, is over 3 miles long and impounds a reservoir extending upstream for 372 miles. Some of this water will be used to irrigate 5,000,000 acres of land and water 17,000,000 acres of fertile crop and pasture land.

The harnessing of the power of the Volga began before the war with the construction of three comparatively small power stations at Ivankovo, Uglich and Rybinsk on the upper reaches of the river. The Volga and Kama cascades will comprise thirteen power stations of which seven are already in operation, while two more, Saratov and Votkinsk, are under construction. The remaining stations, Cheboksary, Lower Volga, Upper Kama, and Lower Kama, are to be built within the next ten years. The scheme includes the drawing-off of part of the flow of the northern rivers Pechora and Vychegda into the Volga, by way of the River Kama. Total installed capacity of the Volga–Kama cascades will record 15,000MW and annual generation will be of the order of 60,000 million kWh. In addition, there will be improvements to navigation, agriculture, and fisheries.

Fig. 7—Booking hall at Cairoli station

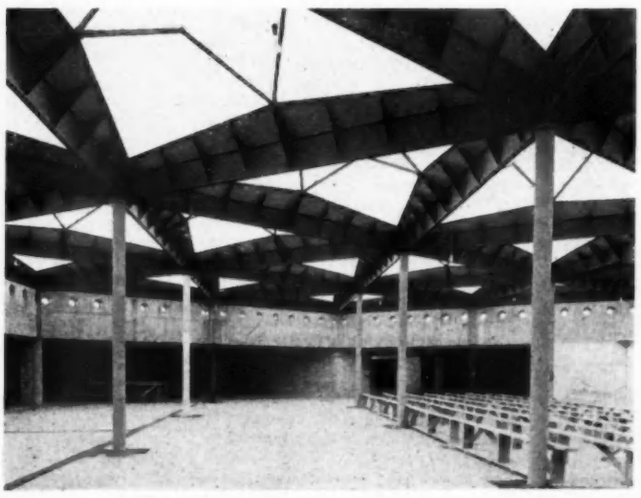


Fig. 8—Booking hall at Fiera station

THE AMERICAN SCENE

By Our American Editor

Semiconductor Device for Amplification of Ultrasonic Waves

ULTRASONIC waves have been amplified directly in a piezoelectric semiconductor crystal at the Bell Telephone Laboratories, Murray Hill, New Jersey. The sound waves are amplified by interaction with electrons drifting in the crystal, in much the same way that electromagnetic waves are amplified in a travelling wave tube. A new class of solid-state electronic devices such as amplifiers, oscillators, delay lines and isolators now appears possible based on the combination of piezoelectricity and semiconduction in certain crystals.

This new method of amplification was first proposed by Dr. D. L. White of the Bell Lacoratories while investigating ultrasonic attenuation in piezoelectric semiconductors with Dr. A. R. Hutson. They report that they have amplified an ultrasonic wave travelling through a crystal of cadmium sulphide (CdS) by applying a d.c. electric field in the direction of wave propagation. They observed gains of 18 dB in a 15 megacycle wave and 38 dB in a 45 megacycle wave travelling through a 7mm length of CdS.

The amount of amplification obtained depends on the applied voltage and the conductivity of the material. CdS was used in the experiment because large single crystals are available which are strongly piezoelectric and have the required semiconducting properties. Since CdS is also photoconductive, the conductivity can be adjusted to just the right value for amplification by shining light on the crystal. While photoconductive material becomes a better electric conductor when it is illuminated with light, a piezoelectric material produces an electric field when it is mechanically stressed. Conversely, when radio frequency electric signals are applied to a piezoelectric crystal, mechanical vibrations at the same frequency as the signal are generated. The exceptional piezoelectric properties of semiconductors such as CdS and ZnO were discovered by R. A. Hutson in 1960.

The direct amplification of high frequency sound waves is possible because a sound wave travelling in a piezoelectric material produces a longitudinal electric field which travels along with the wave. If the material is also conductive, the electric field will cause currents to flow in the material. Because the piezoelectric field is periodic the electrons bunch together in parts of the ultrasonic wave. The bunched electrons tend to interact with the piezoelectric field and consequently react back on the material changing the velocity and amplitude of the sound wave.

D. L. White conceived the idea that if a d.c. electric field is impressed on the material, so that the bunched carriers are made to drift in the direction of wave propagation faster than the speed of sound, the sound wave will be amplified to the way electro-magnetic waves are amplified in a travelling wave tube. Drs. Hutson and McFee conducted an experiment using a crystal of CdS with quartz transducers on both ends. An r.f. pulse applied to the transducer produced an ultrasonic wave which was propagated through the CdS crystal. It was converted by the transducer at the other end to an r.f. signal which was measured under various conditions of electric field and photo-conductivity. They found that if a d.c. field is impressed on the crystal while it is in the dark, there is no effect on the output signal. Also, if the crystal is illuminated without a drift field, conductivity increases and the sound wave is attenuated. However, if the crystal is illuminated and sufficient voltage is impressed on the crystal to make the carriers drift faster than the velocity of the sound wave, substantial amplification of the sound wave occurs. This verified Dr. White's prediction.

Hutson and McFree also observed that when no signal is put into the device and the drift field is applied for a comparatively long time, r.f. acoustic energy builds up from thermal noise. Ultrasonic waves propagating through the crystal in the direction of the drift field are amplified. Gain in this direction more than compensates for energy lost by reflection at the ends of the crystal and for energy lost as the waves traverse the crystal in the reverse or non-amplifying direction. Thus the crystal becomes an oscillator.

It is felt that this demonstration of direct amplification of ultrasonic wave energy suggests the possibility of a new family of solid-state devices, including travelling wave amplifiers, oscillators, and loss-less, high-frequency delay lines which may have significant advantages over the existing devices.

Multiple Diodes for Computers

Introduction of a multiple germanium switching diode is announced by the Radio Corporation of America as a contribution to simplifying computer manufacture. The multiple diodes consist of two and three semiconductor diodes packaged as single, integrated units. They are expected to simplify the assembly of computers by reducing the number of separate components and connections required in the construction of logic circuits. Other benefits are quicker assembly, space savings and lower production costs. They are made in triple and twin form.

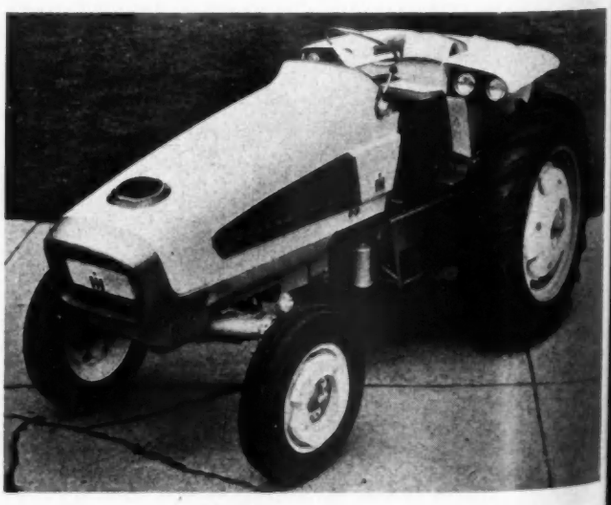
Forward voltage drop at 5mA is 0·4V maximum, and the reverse breakdown voltage −20V. Reverse current at −2V, with a junction temperature of 55 deg. Cent., is 15 microamp maximum.

Gas Turbine Driven Tractor with Hydrostatic Transmission

An 80 h.p., single-shaft "Titan T62T" gas turbine, a product of the Solar Aircraft Company, has been installed, together with hydrostatic transmission, in the latest research tractor of the International Harvester Company. The turbine is 21in long, less than 13in in diameter and weighs only 90 lb with reduction gearing. The "Titan T62T" is similar in basic principle to other gas turbines ; air is drawn in, compressed, and then mixed with fuel in a combustion chamber. Hot gases produced from ignition of the air-fuel mixture spin a vaned turbine wheel. The engine in the tractor has a single turbine which turns the output shaft directly, producing constant engine speed. The tractor, known as the "HT-340" can, at present, use only about half of the turbine's rated horsepower as the transmission was originally designed to operate with a 40 h.p. piston engine. Gearing reduces the speed of the turbine output shaft to 2000 r.p.m.

Forward and reverse speeds on the experimental tractor are infinitely variable, it starts readily at low temperatures and is notably free of vibration. Its acceleration and torque characteristics, the company states, are excellent. Maximum speed is at present 11 m.p.h. To start the engine, the operator pushes a button, and an automatic sequence box takes over to connect the starter and energise solenoids. Apart from steering, the operator has then only to move a transmission lever to change forward and reverse speeds and to stop. The skin of the research tractor is of moulded Fibreglass.

The tractor was built in order to get experience for a quantitative evaluation of this type of power system. Despite recent progress, the company says, fuel economy remains a big question in the minds of all who are interested in using turbines to propel ground vehicles, and it points out that it makes no claims for the vehicle's fuel economy. Heat exchangers, or regenerators, to recover heat from exhaust for preheating intake air, it states, would seem to be the answer. The company is already working with regenerative cycle engines, and that, it says, will be its next step. This should also solve the problem of heat at the exhaust stack, which, with a regenerator, will actually be less than that in a piston engine.



International Harvester research tractor

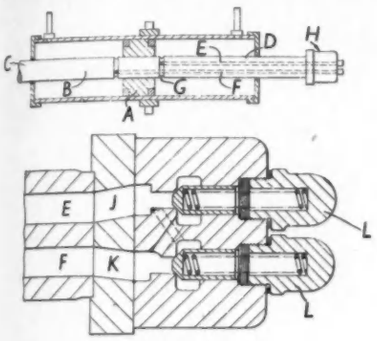
BRITISH PATENT SPECIFICATIONS

The dates printed are those of application and publication on completion. Copies of specifications may be obtained at the Patent Office Sales Branch, Southampton Buildings, Chancery Lane, W.C.2, 3s. 6d. each

HYDRAULIC EQUIPMENT

876,274. June 21, 1960.—HYDRAULICALLY OR PNEUMATICALLY OPERATED RAMS, Stothert and Pitt, Ltd., Bath, Somerset.

This invention relates to hydraulically or pneumatically operated rams and more particularly to means for decelerating the movement of the piston. Referring to the drawing the ram comprises a cylinder in which the piston *A* is fixed to piston rod *B* which extends through both ends of the cylinder. The working end *C* of the piston is adapted to be connected to a movable part of the equipment concerned and the cylinder is arranged to be pivotally connected by trunnions to a fixed part. The other end of the piston rod (referred to as the dummy end) *D* is free and serves to provide a more rigid ram construction. Extending axially along the dummy end of the rod are two passages *E* and *F*. The inner



No. 876,274

end of the passage *E* communicates, through an annular peripheral groove *G* in the dummy end of the rod, with one end of the working chambers of the cylinder. The inner end of the passage *F* extends beyond the piston and communicates, through an annular peripheral groove, with the other working chamber. On the end of the piston rod is a valve assembly *H* with a casing having two bores *J* and *K* which communicate respectively with the two bored passages *E*, *F*. The bores and the passages can be placed in communication with one another through openings which are under control of spring operated pressure relief valves *L*. Each valve *L* is arranged to open automatically to permit flow of fluid from one of the ram working chambers to the other when the difference in pressure exceeds a predetermined value. However the controls are operated to move or check the ram piston in either direction the appropriate valve *L* will determine the maximum force which can be applied to the piston. By adjusting the spring pressure applied to the valves, the maximum stresses which can be applied to the ram and thus also to the equipment on which it is mounted, during acceleration or deceleration of the piston can be limited. Since the relief valves are mounted externally their adjustment to vary the safe pressure according to requirements can be affected without dismantling the apparatus in any way. A modified construction is also illustrated in the specification.—*August* 30, 1961.

ELECTRONICS

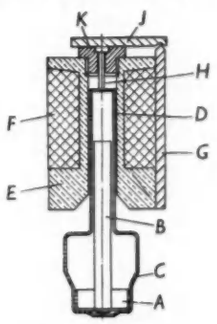
875,388. April 23, 1958.—INFORMATION STORAGE MATRICES EMPLOYING MAGNETIC CORES, Mullard Ltd., Abacus House, 33, Gutter Lane, London, E.C.2. (*Inventor: Russell Edward Winn.*)

Sometimes it is required to produce a memory matrix in which a certain preset pattern of fixed information is to be stored which will not be destroyed during read-in or read-out operations. A simple method would consist of merely removing those cores which are not used in accordance with the pattern of fixed information. However, removal of cores suffers from the disadvantage that the pattern of fixed information cannot be changed in a given matrix and a separate matrix will be necessary for each change of fixed information. In order to overcome this disadvantage it is common practice to link those cores required for certain patterns of fixed information by means of additional conductors through which a saturating current may be applied. This practice suffers from the disadvantage that a very large number of leads and terminals are required and it is an object of this invention to provide a simple means of producing any given pattern of fixed information in a memory matrix. In one embodiment a matrix includes a number of guides registered relative to the respective cores, each guide having an associated permanent magnet and means for selectively urging the magnets into association with the cores. In an alternative embodiment there is provided a plate having substantially the same format as the matrix and carrying permanent magnets positioned so that only selected cores in the matrix are saturated when the plate is held in register with the matrix. Another embodiment provides tubular guide means each registered relative to a core in a matrix, each guide having an associated rod-shaped permanent magnet which is urged by means of helical spring members on to its associated core. A mask such as a punched card having apertures corresponding to a desired pattern of information is interposed between the guides and the cores to provide selective means for saturating the cores. A mask or punched card may be used in combination with this invention either as a means for selecting a desired fixed pattern of information or as a means for reading information from a coded punched card. In the latter form a punched card which is desired to be read is interposed between the magnets and the matrix cores ; the magnets are then urged towards the cores so that only those magnets exposed through the apertures in the card saturate their associated cores. The memory matrix now contains a pattern of inoperative cores corresponding to that in the punched card or mask. Electromagnetic means may be employed for lifting and lowering the magnets. Alternatively hydraulic means may be used in conjunction with the guides. In a further embodiment the permanent magnets, which may be of horseshoe form, are adapted to plug in a plate parallel to the matrix so that each core may be individually saturated by inserting the magnet into the plate in the appropriate core position.—*August* 16, 1961.

DASHPOTS

876,323. June 24, 1958.—DASHPOTS, Allen West and Co., Ltd., Lewes Road, Brighton, 7, Sussex, and Wilfred Turner, of the company's address.

This invention has for its object the provision of a dashpot in which dust and foreign matter will be prevented from entering the cylinder and the fluid will be prevented from leaking. The dashpot shown in the drawing comprises a plunger consisting of a piston *A* with a rod *B* of magnetic material projecting coaxially upwards. The plunger is enclosed in a cylinder consisting of a cylinder proper *C* and an elongated coaxial upward extension *D* of relatively



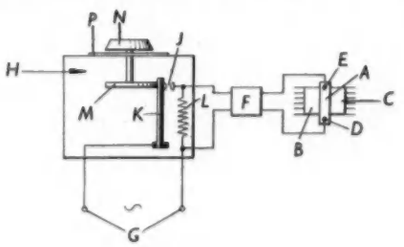
No. 876,323

small diameter into which the rod is an easy sliding fit. Closely surrounding the cylinder extension is the insulating bobbin *E* of a solenoid *F*, which is mounted on a fixed frame *G* of magnetic material. The cylinder is suspended in the position shown by an actuating rod *H*. A holding-down armature *J* which is hinged to the upper end of the frame normally rests horizontally on the upper end of the plug *K*. When a current is passed through the solenoid a magnetic field is generated which passes through the upper portion of the rod, the plug, armature, frame and back to the rod. An upward force therefore acts on the rod and, owing to the retardation of the piston by the lower cylinder portion, this upward force is transmitted to the cylinder element *C*, *D*, and through the actuating rod *H* to the holding-down armature. At the same time, however, the magnetic field produces a downward force on the holding-down armature and this is sufficient to prevail over the upward force so that the cylinder element remains stationary. The greater the current in the solenoid the greater will be the upward force on the cylinder, but the greater also will be the downward force on the holding-down armature so the cylinder element, at this stage, will always remain stationary. The upward force will move the piston, subject to retardation, upwards in the lower portion of the cylinder proper, at a speed according to the current until the piston clears the lower cylinder portion when the plunger will rise freely and very rapidly. This rapid rise will continue until the upper end of the rod *H* strikes the top of the cylinder extension *D*. It will be seen that the speed of the rise will increase up to the point of impact, and that at impact the rod will be well within the solenoid. Consequently the upward force exerted on the upper end of the extension *D* at the moment of impact, being the sum of the force due to the kinetic energy of the plunger and the increased magnetic force exerted on the rod will be great, and the arrangement is such that it is sufficient to raise the cylinder, the rod and the armature *J*. The raising of the armature effects the operation which the dashpot is designed to control. It will be seen that the plunger is completely enclosed by the cylinder which forms a sealed container.—*August* 30, 1961.

THERMOELECTRIC DEVICES

875,478. October 8, 1958.—THERMOELECTRIC COOLING DEVICES, The General Electric Company, Ltd., Magnet House, Kingsway, London, W.C.2. (*Inventor: Harry Bury.*)

According to the present invention, an electrical supply circuit for an assembly of thermojunctions includes an energy regulator as herein defined which may be set to control the supply of current to the thermojunctions, and hence to regulate the temperature difference between the hot and the cold junctions, in accordance with the ambient temperature. The energy regulator may conveniently be a " Simmer " switch having a linear cam and a dial graduated to read ambient temperature. In conventional refrigerators, for example of the compressor-evaporator type, it is usual to control the input power by means of a thermostat responsive to the evaporator temperature. In contrast to this the energy regulator of the present invention may be set by hand. Referring to the drawing, a thermocouple assembly *A*, arranged to be mounted in the wall of a refrigerating chamber (not shown) has hot and cold junctions



No. 875,478

disposed on its opposite sides, and heat exchange members *B* and *C* are mounted in thermal contact with the hot and the cold junctions respectively. The assembly has a pair of electric terminals *D* and *E*, and is supplied from a power pack *F* connected to an alternating current supply *G* through an energy regulator in the form of a " Simmer " switch *H*. The energy regulator comprises essentially a micro-gap switch *J*, a bimetallic element *K* for operating the micro-gap switch, a heating element *L* for heating the bimetallic element, and a linear cam *M* for adjusting the setting of the bimetallic element. The cam is arranged to be set manually by a knob *N* in accordance with ambient temperature, there being associated with the knob a dial *P* calibrated accordingly. The calibration of the dial is such as to provide for an ambient temperature of say 80 deg. Fah. a cold junction temperature of 40 deg. Fah., the current supply to the thermocouples being in this case continuous. For lower ambient temperatures the regulator *H* would be readjusted accordingly and the current supply would be intermittent, the on-off ratio of the current being dependent upon the regulator setting and providing as before a cold junction temperature of 40 deg. Fah.—*August* 23, 1961.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office not later than a fortnight before the meeting. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

To-day, Oct. 6.—LIVERPOOL AND DISTRICT BRANCH : Industrial Development Centre, M.A.N.W.E.B., Paradise Street, Liverpool, 1, " Applications and Failures of Ball and Roller Bearings," R. W. Jones, 7.30 p.m.

Mon., Oct. 9.—HALIFAX BRANCH : Griffin Hotel, George Street, Halifax, " Solderless Connections," A. S. Ferguson, 7.45 p.m. ★ CENTRAL LONDON BRANCH : White Hall Hotel, Bloomsbury Square, London, W.C.1, " Electrical Supplies—London Underground System," D. F. Hudson, 7.15 p.m. ★ N.W. LONDON BRANCH : Century Hotel, Wembley, " Diesel-electric Locomotives," A. V. Stewart, 8.15 p.m.

Tues., Oct. 10.—ALDERSHOT AND DISTRICTS BRANCH : Station Hotel, Basingstoke, " Modern Cable Jointing," 8 p.m. ★ CHESTER AND DISTRICTS BRANCH : The Blossoms Hotel, Chester, " Industrial Application of Photo-electric Cells," A. C. Stewart, 7.45 p.m. ★ GLASGOW BRANCH : Kenilworth Hotel, 5, Queen Street, Glasgow, C.2, " Electrical Distribution," 8 p.m. ★ GLOUCESTER AND DISTRICT CENTRE : Royal Hotel, Station Road, Gloucester, " Flameproofness and Intrinsic Safety," W. Bevan Whitney, 8 p.m. ★ LEICESTER BRANCH : Westcotes Constitutional Club, 124, Wilberforce Road, Leicester, " Safety of an Electrical Installation," F. E. Noakes, 7.30 p.m. ★ YORK BRANCH : Royal Station Hotel, York, " Modern Development in Mechanical Power Transmission," 7.30 p.m.

Wed., Oct. 11.—BIRMINGHAM BRANCH : The Engineering and Building Centre, Stephenson Place, Birmingham, 2, " Industrial Application of Photo-electric Cells," G. A. G. Ive, 7.30 p.m. ★ BRISTOL AND WEST OF ENGLAND BRANCH : The Turk's Head Hotel, Exeter, " Protective Equipment for Industrial Plant," W. L. Stern, 8 p.m. ★ EAST ANGLIA (THETFORD) CENTRE : The Red Lion Hotel, Thetford, Norfolk, " Recent Developments in Fluorescent Lighting," G. V. McNeill, 7.30 p.m.

Thurs., Oct. 12.—BRADFORD AND DISTRICT BRANCH : The Midland Hotel, Bradford, " A New Approach to Traction Battery Charging," D. Kirkby, 7.30 p.m. ★ NOTTINGHAM BRANCH : People's College of Further Education, Castle Road, Nottingham, " Control Centres for Modern Industry," R. Ritchie, 7.30 p.m.

BRITISH COAL UTILISATION RESEARCH ASSOCIATION

Wed., Oct. 11.—Conway Hall, Red Lion Square, London, W.C.1, " The Position of Coal in Electric Power Generation," L. Rotherham, 5.30 p.m.

BRITISH ELECTRICAL AND ALLIED MANUFACTURERS' ASSOCIATION

To-day, Oct. 6.—Connaught Rooms, London, W.C.2, Golden Jubilee Export Conference.

BRITISH INSTITUTION OF RADIO ENGINEERS

To-day, Oct. 6.—SOUTH MIDLANDS SECTION : North Gloucestershire Technical College, Cheltenham, " Colour Television," P. S. Carnt, 7 p.m.

Wed., Oct. 11.—S.W. SECTION : School of Management Studies, Unity Street, Bristol, " General Introduction of Inertial Navigation," R. Collinson, " Components and Techniques Employed in Inertial Navigation Systems," E. Bristowe, 7 p.m. ★ N.E. SECTION : Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road, Newcastle upon Tyne, " V.H.F. Communications Receivers and Transmitters using Transistors," A. J. Rees or B. S. Cowle, 6 p.m.

BRITISH IRON AND STEEL RESEARCH ASSOCIATION

Wed. to Fri., Oct. 11 *to* 13.—Harrogate, Hydrogen in Steel Conference, Opening lecture by Professor A. R. Troiano who will deal with the role of hydrogen in the mechanical behaviour of metals.

ILLUMINATING ENGINEERING SOCIETY

Mon., Oct. 9.—LIVERPOOL CENTRE : Industrial Development Centre, Paradise Street, Liverpool, Chairman's Address, N. Blackman, 6 p.m. ★ SHEFFIELD CENTRE : Grand Hotel, Sheffield, Chairman's Address, B. Ruston, 6.30 p.m.

Tues., Oct. 10.—Royal Institution, Albemarle Street, London, W.1, Presidential Address, " The Society's Contribution to Lighting Technology," W. T. Souter, 6 p.m. ★ STOKE-ON-TRENT GROUP : North Stafford Hotel, Stoke-on-Trent, " Stage Lighting," B. Legge, 6 p.m.

INSTITUTE OF BRITISH FOUNDRYMEN

Wed., Oct. 11.—SOUTHAMPTON SECTION : Technical College, St. Mary's Street, Southampton, " Use of Oxygen in Cupolas and Other Developments," C. H. King, and F. B. Lawrence. 7.30 p.m.

Thurs., Oct. 12.—BEDS. AND HERTS. SECTION : K. and L. Steelfounders and Engineers, Ltd., Letchworth, Herts., Presidential Address followed by film show, 7.30 p.m.

INSTITUTE OF MARINE ENGINEERS

Mon., Oct. 9.—WEST OF ENGLAND SECTION : Small Engineering Lecture Theatre, The University, University Walk, Bristol, 8. " Water Treatment for High Pressure Marine Boilers," T. V. Arden and F. C. Blight, 7.30 p.m.

Tues., Oct. 10.—DEVON AND CORNWALL SECTION : Demonstration Theatre, S.W. Gas Board, Radiant House, Derry's Cross, Plymouth, " Marine Refrigeration Machinery," Lt. Cdr. M. B. F. Ranken, 7.15 p.m. ★ LONDON SECTION : Memorial Building, 76, Mark Lane, London, E.C.3, " A Critical Survey of Marine Water Treatment Methods," I. Raleigh, 5.30 p.m.

Wed., Oct. 11.—SCOTTISH SECTION : Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, " Safety at Sea," J. W. Bull, 7.30 p.m.

Thurs., Oct. 12.—N.E. COAST SECTION : Stephenson Building, King's College, Claremont Road, Newcastle upon Tyne, " The Design and Layout of a 22,000 S.H.P. Tanker Machinery Installation," J. B. Main, 6.15 p.m.

INSTITUTE OF METALS

Mon., Oct. 9.—SCOTTISH LOCAL SECTION : Institution of Engineers and Shipbuilders, Elmbank Crescent, Glasgow, C.2, " Physical Methods of Analysis for Major Alloying Constituents," K. M. Bills, 6.30 p.m. ★ TYNE WEAR METALLURGICAL ASSOCIATION : Metallurgy Department, King's College, Haymarket, Newcastle upon Tyne, " Modern Developments in Steelmaking," J. Pears, 6.30 p.m.

Tues., Oct. 10.—S. WALES LOCAL SECTION : Metallurgy Department, University College, Swansea, " Welding of Non-Ferrous Metals," J. G. Young, 6.30 p.m.

Thurs., Oct. 12.—BIRMINGHAM LOCAL SECTION : College of Advanced Technology, Gosta Green, Birmingham, " Some Problems in the Development of Fuel Cells," A. D. S. Tantram, 6.30 p.m.

INSTITUTE OF REFRIGERATION

Thurs., Oct. 12.—Institute of Marine Engineers, 76, Mark Lane, London ,E.C.3, Presidential Address ,C. M. Brain ,5.30 p.m.

INSTITUTE OF ROAD TRANSPORT ENGINEERS

Tues., Oct. 10.—MIDLANDS CENTRE : Engineering Centre, Birmingham, " Research on the Testing and Performance of Commercial Vehicle Brakes," R. D. Lister, 7.30 p.m. ★ WESTERN CENTRE : Royal Hotel, Bristol, " Wheels Round the World," films and discussion, 7.30 p.m.

Wed., Oct. 11.—SOUTHERN CENTRE : Cambridge Hotel, Southsea, " Wheels Round the World," and " Off the Beaten Track," films and discussion, 7.30 p.m.

Fri., Oct. 13.—S. WALES CENTRE : S. Wales Institute of Engineers, Park Place, Cardiff, " Wear and Tear (Part II)," J. E. Johnson, 7.15 p.m.

INSTITUTION OF CIVIL ENGINEERS

Tues., Oct. 10.—Great George Street, Westminster, London, S.W.1, Informal discussion, " Site Organisation," introduced by R. S. Read, 5.30 p.m.

Thurs., Oct. 12.—Great George Street, Westminster, London, S.W.1, " Some Developments in the Activated Sludge Process," J. McNicholas, 5.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

To-day, Oct. 6.—MEDICAL ELECTRONICS DISCUSSION GROUP : Savoy Place, London, W.C.2, Discussion on " What is pH and its Measurements?," opened by G. Mattock and G. R. Taylor, 6 p.m.

Mon., Oct. 9.—LONDON GRADUATE AND STUDENT SECTION—ARBORFIELD DISTRICT : Unit Cinema, 3 (Tels.) Training Bn., R.E.M.E., Arborfield, Berks., Chairman's Address, " Experimental Techniques Developed for Determining the Performance of Fuel Elements in Nuclear Reactors," C. F. Price, 7 p.m. ★ ANGLIAN SUB-CENTRE : Electric House, Ipswich, Chairman's Address, " Telephones and the Future," E. Hoare, 6.30 p.m. ★ N.E. CENTRE : Neville Hall, Westgate Road, Newcastle upon Tyne, Chairman's Address, P. Richardson, 6.15 p.m. ★ SCOTTISH ELECTRONICS AND MEASUREMENT GROUP : Royal College of Science and Technology, Glasgow, Chairman's Address, W. H. P. Leslie, 6 p.m. ★ S. MIDLAND CENTRE : B.B.C. Engineering Department, Wood Norton, Annual General Meeting, " Television Camera Tubes," B. S. Pover, 7 p.m. ★ WESTERN CENTRE : S. Wales Institute of Engineers, Park Place, Cardiff, Chairman's Address, T. Gill, 6 p.m.

Tues., Oct. 10.—MEASUREMENT AND CONTROL SECTION : Savoy Place, London, W.C.2, Chairman's Address, " Trends in Computer Engineering," W. S. Elliott, 5.30 p.m. ★ N. MIDLAND CENTRE : H.Q. Mess, School of Signals, Catterick Camp, " Power from the Atom by Fission and Fusion," K. W. Huddart 6.15 p.m. ★ N.W. UTILISATION GROUP : Engineer's Club, Albert Square, Manchester, 2, Chairman's Address, " Project Planning," D. Marshall, 6.15 p.m. ★ N. IRELAND CENTRE : David Keir Building, Queen's University, Stranmillis Road, Belfast, 9, Chairman's Address, " Planning in Electric Power Supply Industry," W. Szwander, 6.30 p.m. ★ SCOTTISH ELECTRONICS AND MEASUREMENT GROUP : Carlton Hotel, Edinburgh, Chairman's Address, W. H. P. Leslie, 7 p.m. ★ SOUTHERN ELECTRONICS AND CONTROL GROUP : The University, Southampton, Chairman's Address, E. Wolfendale, 6 p.m.

Wed., Oct. 11.—N.E. CENTRE : Technical College, Carlisle, " Progress in Oil-Filled Cables and their Accessories," A. N. Arman, F. J. Miranda and G. R. Bishop, " The Influence of the Ageing on the Characteristics of Oil-Filled Cable Dielectric," P. Gazzana-Priaroggia, G. L. Palandri and U. A. Pelagatti, 7 p.m. ★ N. LANCASHIRE SUB-CENTRE : N.W.E.B. Demonstration Theatre, Friargate, Preston, Chairman's Address, F. Clegg, 7.30 p.m. ★ RUGBY SUB-CENTRE : College of Engineering Technology, Rugby, Chairman's Address, K. J. R. Wilkinson, 6.30 p.m. ★ OXFORD DISTRICT MEETING : Southern Electricity Board, 37, George Street, Oxford, " The Developing Engineer," J. E. L. Robinson, 7 p.m.

Thurs., Oct. 12.—UTILISATION SECTION : Savoy Place, London, W.C.2, Chairman's Address, " Research in the Field of Electricity Utilisation," H. G. Taylor, 5.30 p.m. ★ E. MIDLAND CENTRE : E.M.E.B. Showrooms, Spalding, " The I.E.E. Wiring Regulations," Forbes Jackson, 7.30 p.m. ★ N. SCOTLAND SUB-CENTRE : Electrical Engineering Department, Queen's College, Dundee, Centre Chairman's Address, E. G. Cullwick, 6 p.m. ★ W. WALES (SWANSEA) SUB-CENTRE : Electricity Board Showrooms, The Kingsway, Swansea, Chairman's Address, W. E. Lewis, 6 p.m.

Fri., Oct. 13.—N. SCOTLAND SUB-CENTRE : Robert Gordon's Technical College, Aberdeen, Centre Chairman's Address, E. G. Cullwick, 6 p.m.

INSTITUTION OF ENGINEERS-IN-CHARGE

Wed., Oct. 11.—Caxton Hall, London, S.W.1, " Sources of Technical Information," Ezer Griffiths, 6.30 p.m.

INSTITUTION OF HEATING AND VENTILATING ENGINEERS

To-day, Oct. 6.—MANCHESTER AND DISTRICT BRANCH : Engineers' Club, Albert Square, Manchester, " A New Approach to the Psychorometric Chart," G. R. Binns, 6.30 p.m.

Tues., Oct. 10.—BIRMINGHAM AND DISTRICT BRANCH : Engineering Centre, Stephenson Place, Birmingham, " Aspects of Boiler Chimney Design to Avoid Corrosion and Smut Emission," W. R. Carter, 6.30 p.m. ★ S.W. BRANCH : R.W.A. School of Architecture, Bristol, " Methods of Measurement," J. M. Cooling, 6.30 p.m.

INSTITUTION OF MECHANICAL ENGINEERS

Sat., Oct. 7.—SOUTHERN GRADUATES' SECTION : Visit to the Subscriber Trunk Dialling Telephone Exchange, Aldershot, 10 a.m.

Tues., Oct. 10.—AUTOMOBILE DIVISION : 1, Birdcage Walk, Westminster, London, S.W.1, Annual Meeting, Chairman's Report for 1960-61 and induction of new Chairman. Followed at 6.30 p.m. by Ordinary Meeting at which the Chairman will deliver his Address. ★ E. BRANCH : Red Lion Hotel, Colchester, " The Bearing of Psychology and Medicine upon Engineering," Sir Frederic Bartlett, 7.30 p.m. ★ SCOTTISH GRADUATES' SECTION : Visit to Brown Brothers and Co., Ltd., Rosebank Iron Works, Edinburgh, 7, 6.30 p.m. ★ SOUTHERN GRADUATES' SECTION : The Sun Hotel, Chatham, Film Show, 7.30 p.m.

Wed., Oct. 11.—ORDINARY MEETING : 1, Birdcage Walk, Westminster, London, S.W.1, " The Design and Manufacture of Cigarette Making Machines," Desmond Molins, 6 p.m.

★ SOUTHERN GRADUATES' SECTION : Grand Hotel, Bournemouth, " Primary Production and Semi-fabrication of Aluminium and its Alloys," P. N. Doherty, 7.30 p.m. ★ WESTERN GRADUATES' SECTION : The University, Bristol, " Motor Racing," Graham Hill, 7.30 p.m.

Thurs., Oct. 12.—SOUTHERN GRADUATES' SECTION : Sports Pavilion, A.W.R.E. Aldermaston, " Radio Isotopes in Engineering," W. G. Busbridge, 3 p.m. ★ YORKSHIRE GRADUATES' SECTION : Technical College, Wakefield, " Roof Supports in Coalmines," S. G. Harris, 6.45 p.m.

INSTITUTION OF PLANT ENGINEERS

To-day, Oct. 6.—BIRMINGHAM BRANCH : Hare and Squirrel Hotel, Cow Lane, Coventry, Ladies' Evening, 7.30 p.m.

Tues., Oct. 10.—LONDON BRANCH : Royal Society of Arts, John Adam Street, Adelphi, London, W.C.2, Film Evening, 7 p.m. ★ EDINBURGH BRANCH : 25, Charlotte Square, Edinburgh, " The Organisation of Preventive Maintenance," D. C. Muirhead, 7.30 p.m. ★ MANCHESTER BRANCH : Literary and Philosophical Society, George Street, Manchester, " The Trends and Progress of Nuclear Power Station Design," W. G. Busbridge, 7.15 p.m.

Wed., Oct. 11.—WESTERN BRANCH : Main Engineering Lecture Theatre, The University, Bristol, " The Role of Construction Materials in Chemical Engineering," John Leyland, 7 p.m.

Thurs., Oct. 12.—GLASGOW BRANCH : Scottish Building Centre, 425, Sauchiehall Street, Glasgow, " Accident Prevention from the Plant Engineer's Standpoint," 7.15 p.m. ★ N.E. BRANCH : Roadway House, Oxford Street, Newcastle upon Tyne, " Management Problems in a Maintenance Department," T. Gormley, 7 p.m. ★ SHEFFIELD AND DISTRICT BRANCH : Blue Bell Hotel, Scunthorpe, " Problems in Rolling Mills," W. Bailey, 7.30 p.m.

INSTITUTION OF PRODUCTION ENGINEERS

Mon., Oct. 9.—NORTH WESTERN REGION : Reynolds Hall, Manchester College of Science and Technology, Sackville Street, Manchester, " Spark Machining and Similar Processes," K. Appelbee, 7.15 p.m.

Tues., Oct. 10.—DONCASTER SECTION : Technical College, Waterdale, Doncaster, " Cold Extrusion," H. A. J. Dennison, 7 p.m. ★ BIRMINGHAM GRADUATE SECTION : James Watt Memorial Institute, Birmingham, " Manufacturing Techniques on the Armstrong Whitworth Argosy," R. A. Courtney and A. W. Menzies, 7 p.m.

Wed., Oct. 11.—COVENTRY GRADUATE SECTION : Courtaulds Lecture Theatre, Lockhurst Lane, Coventry, " Some Future Trends in Machine Tool Design," J. Loxham, 7.30 p.m. ★ PETERBOROUGH SECTION : F. Perkins, Ltd., Conference Room, Peterscourt, Peterborough, " Ball and Roller Bearing Manufacture," J. Anderson, 7.30 p.m. ★ WESTERN GRADUATE SECTION : Main Lecture Theatre, Faculty of Engineering, Queen's Building, The University, Bristol, " The Management—Trade Union Relationship in Industry," S. J. West, and P. E. Stanford, 7.30 p.m.

Thurs., Oct. 12.—PRESTON SECTION : College of Further Education, Sandy Lane, Accrington, " Human Relations in Industry," R. H. J. Rhodes, 7.30 p.m. ★ LONDON SECTION : Royal Aeronautical Society, 4, Hamilton Place, London, W.1, " The Hovercraft," J. M. George, 7 p.m. ★ LONDON GRADUATE SECTION : 10, Chesterfield Street, Mayfair, London, W.1, " Can Electrochemical Cutting Compete," D. J. Fiddes, 7.15 p.m.

Fri., Oct. 13.—IPSWICH AND COLCHESTER SECTION : Electric House, Ipswich, Lecture by R. V. Taylor, 7.30 p.m.

INSTITUTION OF PUBLIC HEALTH ENGINEERS

Wed., Oct. 11.—Caxton Hall, London, S.W.1, Presidential Address, H. D. Manning, 6.30 p.m.

INSTITUTION OF STRUCTURAL ENGINEERS

Mon., Oct. 9.—SCOTTISH BRANCH : Institution of Engineers and Shipbuilders, Glasgow, Chairman's Address, K. D. Mathewson, 7 p.m.

Thurs., Oct. 12.—11, Upper Belgrave Street, London, S.W.1, " Professional Practice and Drawing Office Procedure," L. R. Creasy, 6 p.m. ★ N. COUNTIES BRANCH : Cleveland Scientific and Technical Institution, Middlesbrough, Address by Chairman-Elect, L. Dobson, 6.30 p.m.

Fri., Oct. 13.—WESTERN COUNTIES BRANCH : Queen's Building, University Walk, Bristol, Chairman's Address, Clifford E. Saunders, 6 p.m.

JUNIOR INSTITUTION OF ENGINEERS

To-day, Oct. 6.—Pepys House, 14, Rochester Row, Westminster, London, S.W.1, Illustrated talk, " Lighting Effects of the Palace in Kuwait," R. W. Shaw, 7 p.m.

Fri., Oct. 13.—ORDINARY MEETING : Pepys House, 14, Rochester Row, London, S.W.1, " The Technician, Education and Industry," J. Heywood, 7 p.m.

LIVERPOOL METALLURGICAL SOCIETY

Thurs., Oct. 12.—Department of Metallurgy, The University, Liverpool, 3, Presidential Address, " Metallurgy and the Craftsman," F. R. Brace, 7 p.m.

NATIONAL SOCIETY FOR CLEAN AIR

To-day, Oct. 6.—The Dome, and the Corn Exchange, Brighton, Annual Conference and Exhibition.

NORTH WESTERN FUEL LUNCHEON CLUB

Wed., Oct. 11.—Engineer's Club, 17, Albert Square, Manchester, Presidential Address, D. P. Welman.

RADAR AND ELECTRONICS ASSOCIATION

Thurs., Oct. 12.—Royal Society of Arts, John Adam Street, London, W.C.2, " Space Communications," Part I " Systems and Equipment," L. F. Mathews, 7 p.m.

REINFORCED CONCRETE ASSOCIATION

Tues., Oct. 10.—MIDLAND COUNTIES BRANCH : Birmingham and Midland Institute, Paradise Street, Birmingham, " Architectural Uses of Concrete in the Far East" Philip Langley, 6 p.m.

ROYAL INSTITUTION OF CHARTERED SURVEYORS

Thurs., Oct. 12.—LAND SURVEYORS GENERAL MEETING : 12, Great George Street, London, S.W.1, " Recent Experiences in the Use of the Airborne Profile Recorder," P. G. Mott and J. A. Eden, 5.45 p.m.

SOCIETY OF INSTRUMENT TECHNOLOGY

Wed., Oct. 11.—CONTROL SECTION : Manson House, 26, Portland Place, London, W.1, " Process Control in Paper Mills," H. B. Whitehouse, 6.30 p.m.